US005619260A

United States Patent [19]

Miyadera

[11] **Patent Number: 5,619,260**

[45] **Date of Patent: Apr. 8, 1997**

[54] **STILL VIDEO CAMERA PERFORMING WHITE-BALANCE AND AUTO-FOCUS ADJUSTMENT CONCURRENTLY**

[75] Inventor: **Shunichi Miyadera**, Tokyo, Japan

[73] Assignee: **Asahi Kogaku Kogyo Kabushiki Kaisha**, Tokyo, Japan

[21] Appl. No.: **668,370**

[22] Filed: **Jun. 18, 1996**

Related U.S. Application Data

[63] Continuation of Ser. No. 294,360, Aug. 23, 1994, abandoned.

[30] **Foreign Application Priority Data**

Sep. 6, 1993 [JP] Japan 5-245979

[51] **Int. Cl.**^{6} **H04N 9/73**

[52] **U.S. Cl.** **348/223**; 348/224; 348/262; 348/342; 348/349; 396/225

[58] **Field of Search** 348/223, 224, 348/262, 263, 264, 265, 268, 270, 272, 273, 276, 342, 345, 349, 350; 354/429, 430, 482, 483, 404; H04N 9/73

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,335,397	6/1982	Tamura	358/29
4,626,918	12/1986	Morisawa	358/225
5,070,407	12/1991	Wheeler et al.	358/225
5,111,299	5/1992	Aoki et al.	358/209
5,132,825	7/1992	Miyadera	359/85
5,136,326	8/1992	Yokota et al.	354/476
5,136,674	8/1992	Kakiuchi et al.	385/115
5,155,635	10/1992	Kakiuchi	359/896
5,185,669	2/1993	Kato	358/227
5,198,890	3/1993	Suga	358/29
5,216,248	6/1993	Ikeda et al.	250/237 R
5,398,058	3/1995	Hattori	348/224
5,543,837	8/1996	Aoki et al.	348/264

FOREIGN PATENT DOCUMENTS

56-6585	1/1981	Japan	H04N 9/04

Primary Examiner—John K. Peng
Assistant Examiner—Ngoc-Yen Vu
Attorney, Agent, or Firm—Greenblum & Bernstein P.L.C.

[57] **ABSTRACT**

A still-video camera has a white balance adjustment device. The white balance adjustment device includes a filter film which has a translucent opal filter portion and a transparent filter portion. The filter film is moved by a motor. During a white balance adjustment, the translucent opal filter portion is positioned in front of a first CCD, and in an image recording operation, the transparent filter portion is positioned in front of the first CCD. When the white balance adjustment is to be carried out, an output signal from a second CCD is transmitted to an AF control circuit, and thus an AF adjustment is also performed. The AF adjustment is carried out in such a manner that a spatial frequency of the output signal of the second CCD has a highest value.

14 Claims, 3 Drawing Sheets

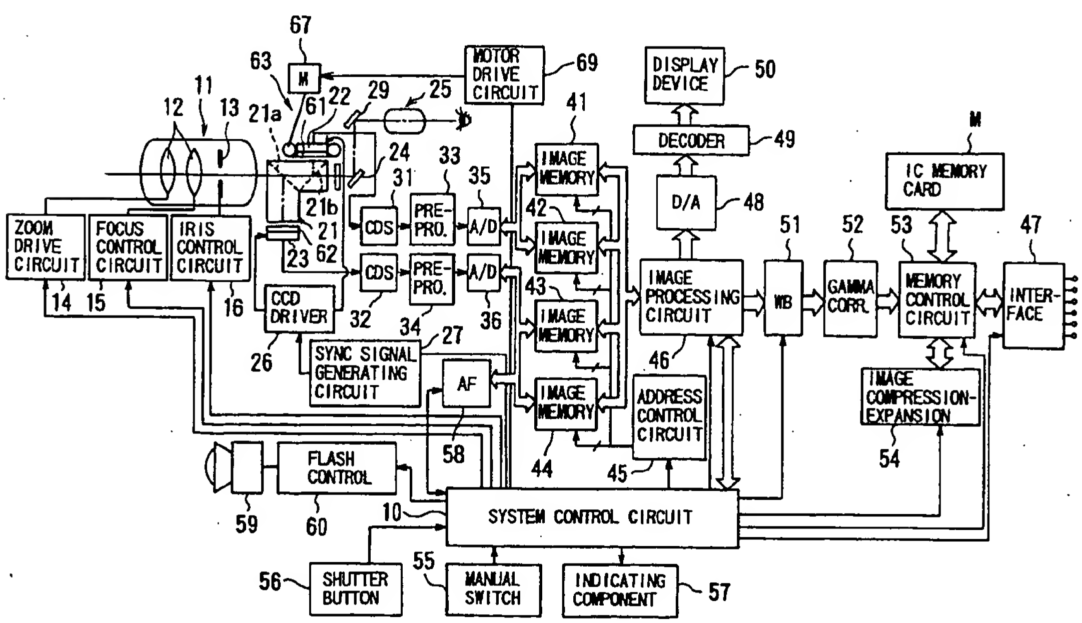


Fig. 1

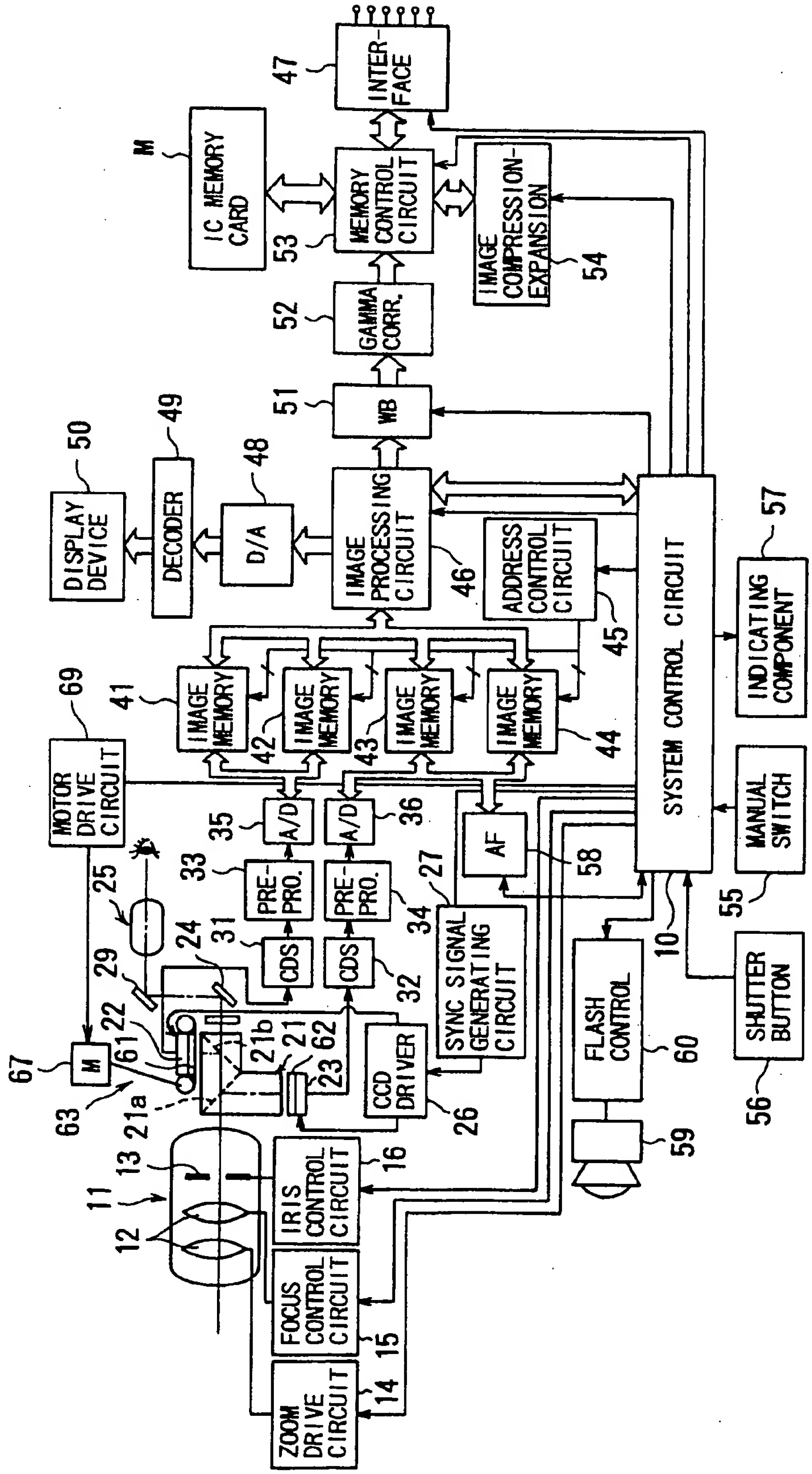

INTER-FACE
47
IC MEMORY CARD
M
MEMORY CONTROL CIRCUIT
53
IMAGE COMPRESSION-EXPANSION
54
GAMMA CORR.
52
WB
51
DISPLAY DEVICE
50
DECODER
49
D/A
48
IMAGE PROCESSING CIRCUIT
46
ADDRESS CONTROL CIRCUIT
45
SYSTEM CONTROL CIRCUIT
10
INDICATING COMPONENT
57
MANUAL SWITCH
55
SHUTTER BUTTON
56
IMAGE MEMORY
41
42
43
44
MOTOR DRIVE CIRCUIT
69
A/D
35
36
AF
58
PRE-PRO.
33
34
CDS
31
32
SYNC SIGNAL GENERATING CIRCUIT
27
FLASH CONTROL
60
59
CCD DRIVER
26
M
67
63
25
29
24
22
61
21b
21
62
23
21a
13
11
12
IRIS CONTROL CIRCUIT
16
FOCUS CONTROL CIRCUIT
15
ZOOM DRIVE CIRCUIT
14

Fig. 2

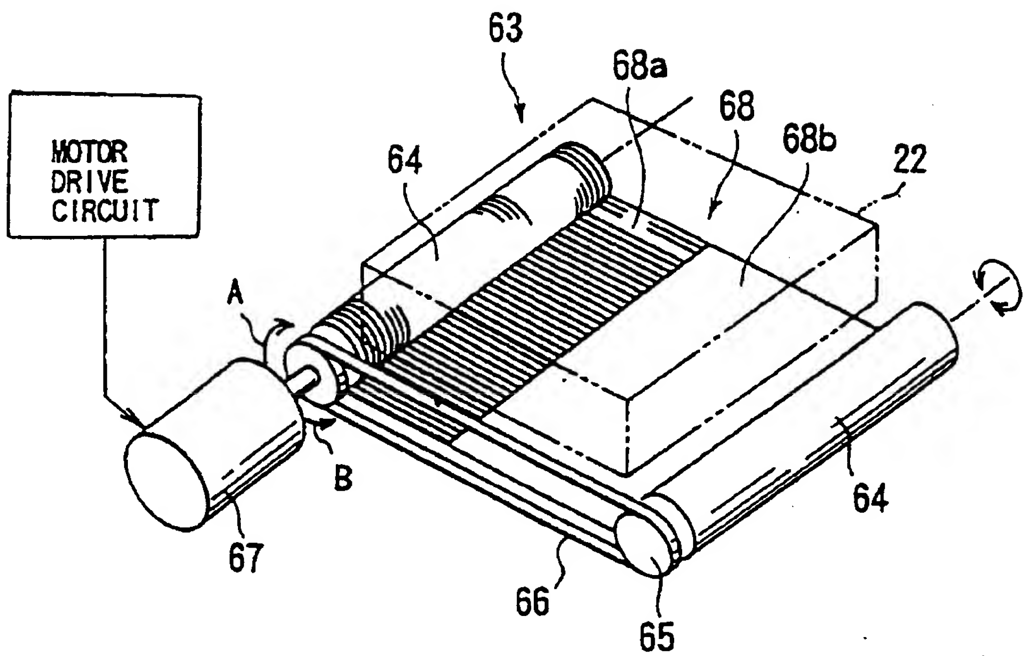
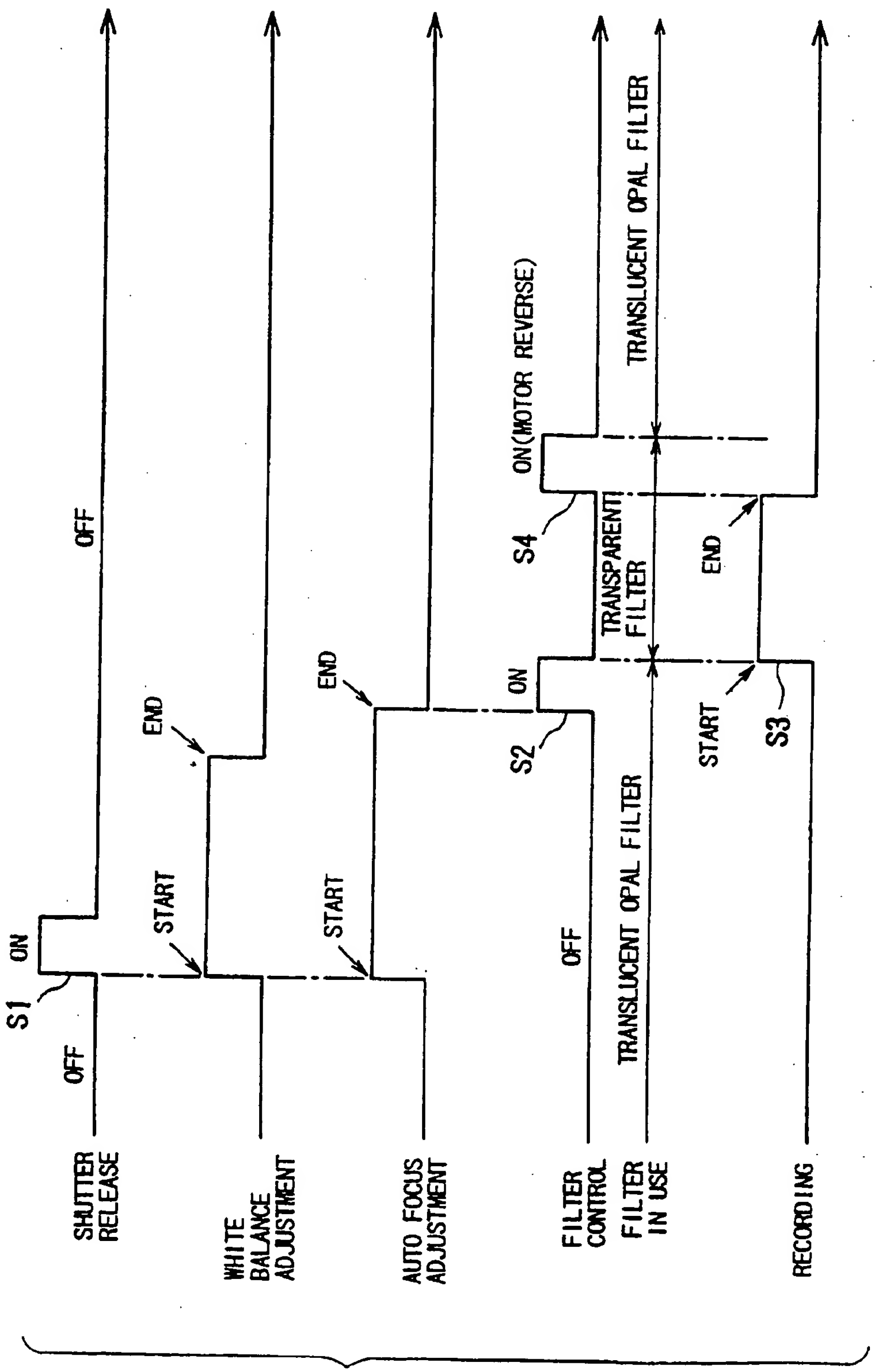


Fig. 3


SHUTTER RELEASE
WHITE BALANCE ADJUSTMENT
AUTO FOCUS ADJUSTMENT
FILTER CONTROL
FILTER IN USE
RECORDING
OFF
S1
ON
OFF
START
END
START
END
S2
ON
S4
ON(MOTOR REVERSE)
OFF
TRANSLUCENT OPAL FILTER
TRANSPARENT FILTER
TRANSLUCENT OPAL FILTER
START
S3
END

STILL VIDEO CAMERA PERFORMING WHITE-BALANCE AND AUTO-FOCUS ADJUSTMENT CONCURRENTLY

This application is a continuation of application Ser. No. 08/294,360, filed Aug. 23, 1994, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a still-video camera having a plurality of imaging devices for obtaining a color image.

2. Description of the Related Art

In a known still-video camera, light from an object entering through a focusing lens is received by an imaging device, and a color still image formed therefrom is recorded on a recording medium. When using such a still-video camera, processes, such as a white balance adjustment, must be carried out before the image is recorded. The white balance adjustment in a TTL system, for example, is performed in a manner in which a translucent opal glass filter cap is attached in front of the taking lens, and a white balance adjustment coefficient is set such that an image of a white object obtained through the imaging device is reproduced as a white image.

Namely, during the operation of a conventional still-video camera, first, a white balance coefficient is stored in a memory of the camera, and then, an auto-focus (AF) adjustment is carried out. Accordingly, the preparations for recording the image includes an operation for attaching and detaching the translucent opal glass filter cap, which takes a long time.

SUMMARY OF THE INVENTION

Therefore, an object of the present invention is to provide a still-video camera in which the delay time, from turning on the still-video camera power supply until the still-video camera can record images, is shortened.

According to the present invention, there is provided a still-video camera which includes first and second imaging devices, a color temperature-sensing filter device, a white balance adjusting mechanism and a focusing mechanism.

The color-temperature-sensing filter device has an optical element movably disposed in front of a light receiving surface of the first imaging device. The white balance adjusting mechanism carries out a white balance adjustment in accordance with an output signal from the first imaging device which receives light through the optical element. The focusing mechanism moves a taking lens in accordance with an output signal of the second imaging device so that the taking lens focuses the image on the second imaging device. The white balance adjusting mechanism and the focusing mechanism are carried out substantially at the same time.

Further, according to the present invention, there is provided a still-video camera which includes first and second imaging devices, a filter, a white balance adjusting mechanism and a lens moving mechanism.

The filter is movable over the light receiving surface of the first imaging device. The white balance adjusting mechanism carries out a white balance adjustment in accordance with an output signal of the first imaging device when the filter covers the light receiving surface. The lens moving mechanism moves a taking lens in accordance with an output signal of the second imaging device so that the taking lens focuses the image on the second imaging device. At least part of the operation of the lens moving mechanism is carried out while the white balance adjustment is carried out.

Furthermore, according to the present invention, there is provided a still-video camera which includes an imaging device, a filter film, a winding mechanism and white balance adjusting mechanism.

The filter film includes a translucent white portion which can be positioned in front of a light receiving surface of the imaging device. The winding mechanism winds the filter film in such a manner that the translucent white portion can be positioned in front of the light receiving surface. The white balance adjusting mechanism carries out a white balance adjustment in accordance with an output signal of the first imaging device when the translucent white portion is positioned in front of the light receiving surface.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be better understood from the description of the preferred embodiments of the invention set forth below, together with the accompanying drawings, in which:

FIG. 1 is a block diagram showing a still-video camera to which an embodiment of the present invention is applied;

FIG. 2 is a perspective view showing an outside appearance of a filter drive device; and

FIG. 3 is a timing chart of a photographing operation of the still-video camera.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will now be described with reference to embodiments shown in the drawings.

FIG. 1 is a block diagram showing a still-video camera to which an embodiment of the present invention is applied.

An imaging optical system **11** has a taking lens **12** and an aperture **13**. The taking lens **12** is composed of a plurality of lens elements and forms a zooming optical system. The positions of the lens elements of the taking lens **12**, along an optical axis, are controlled by a zoom drive circuit **14** and a focus control circuit **15**. The opening of the aperture **13** is adjusted by an iris control circuit **16**. The zoom drive circuit **14**, the focus control circuit **15** and the iris control circuit **16** are controlled by a system control circuit **10**. The system control circuit **10** includes a microcomputer and controls an in-focus control, a color temperature adjustment and the still-video camera as a whole.

Light from an object passes through the imaging optical system 11 and is focused on a first imaging device (CCD) **22** and a second imaging device (CCD) **23**, through a prism **21**, so that the same images are formed on the CCDs **22** and **23**. The light is also passed to a finder optical system **25**, via the prism **21** and mirrors **24** and **29**. The CCDs **22** and **23** are driven by a CCD driver **26**, so that image signals corresponding to the images formed on the CCDs **22** and **23** are supplied to correlation-double-sampling (CDS) circuits **31** and **32** respectively. The CCD driver **26** is operated in accordance with a pulse signal outputted from a synchronizing signal generating circuit **27** controlled by the system control circuit **10**.

The image signals inputted to the CDS circuits **31** and **32** are processed so that reset noise is removed, and then subjected to predetermined processes, such as gamma correction, in pre-process circuits **33** and **34**. The image signals

are then converted to digital signals by A-D converters **35** and **36**, and stored in image memories **41** through **44**. The addresses in the image memories **41** through **44**, at which the image signals are stored, are controlled by the system control circuit **10** through an address control circuit **45**.

An image signal processing circuit **46** is provided for applying a predetermined process to the image signals stored in the image memories **41** through **44**, so that a luminance signal, an R-signal, a G-signal and a B-signal are outputted. These signals pass through the image processing circuit **46**, a D-A converter **48** and a decoder **49**, and are outputted to a display device **50** installed in the still-video camera. Further, these signals are outputted to a memory control circuit **53** through a white balance adjusting circuit **51** and a gamma correction circuit **52**.

The memory control circuit **53** is provided for outputting an image signal formed according to a recording format for an IC-memory card M (a recording medium), and is controlled by the system control circuit **10** through an image compression-expansion circuit **54**. The image compression-expansion circuit **54** compresses the R-signal, the G-signal and the B-signal in a time axis when recording on the recording medium M, and expands these signals in a time axis when reading them from the recording medium M. Namely, the R-signal, the G-signal and the B-signal inputted into the memory control circuit **53** are compressed and recorded on the recording medium M under control of the system control circuit **10**.

In this still-video camera, the R-signal, the G-signal and the B-signal can be outputted to a computer or a display device, which are not shown, through an interface circuit **47**.

A manual switch **55**, a shutter button **56** and an indicating component **57** are connected to the system control circuit **10**. The manual switch **55** and the shutter button **56** are provided for operating the still-video camera, and the indicating component **57** is provided for indicating the state of the manual switch **55**.

This still-video camera has an electronic flash device **59** operated by the system control circuit **10** when the manual switch **55** is operated. The amount of light emitted by the electronic flash device **59** is controlled by the system control circuit **10** through an electronic flash control circuit **60**.

The prism **21** has a first beam-splitter **21*a*** and a second beam splitter **21*b***. The amount of light passed to the first and second CCDs **22**, **23** and the finder optical system **25** are in the ratios 4:4:2; for example, by the operation of the beam splitters **21*a*** and **21*b***, thus, light having the same intensity is passed to each of the CCDs **22** and **23**. Namely, a part of the light entering the prism **21** from the optical system **11** is reflected by the first beam splitter **21*a***, and passed to the second CCD **23**. The rest of the light passes through the first beam splitter **21*a*** to the second beam splitter **21*b***. A part of the light is reflected by the second splitter **21*b***, and passed to the first CCD **22**. The remaining light, i.e., the light which passes through the first and second beam splitters **21*a*** and **21*b***, passes out of the prism **21**. This light is reflected by the mirrors **24** and **29**, and passed to the finder system **25**.

Color filters **61** and **62** are disposed on the light receiving surfaces of the first and second CCDs **22** and **23**, respectively, so that color components of the light reflected by the beam splitters **21*a*** and **21*b*** are sensed. These color filters **61** and **62** have the same construction and are complementary color filters with a checkerboard arrangement in which groups of green (G), magenta (Mg), yellow (Ye) and cyan (Cy) elements are arranged.

A filter drive device **63** (or a color temperature sensing filter device) as shown in FIG. **2** is provided between the first CCD **22** and the prism **21**, so that a color temperature can be sensed and a white balance adjustment can be carried out. The filter drive device **63** has a pair of rollers **64**, disposed at both sides of the first CCD **22**, and a filter film **68** wound around the pair of rollers **64**. Pulleys **65** are connected to the rollers **64**, respectively, and an endless belt **66** is wound around the pulleys **65**. One of the pulleys **65** is connected to an output shaft of the motor **67** driven by a motor drive circuit **69** (see FIG. **1**). The filter film **68** has a translucent opal filter portion **68*a***, i.e., a translucent white portion, and a transparent portion **68*b***. The translucent opal filter portion **68*a*** and the transparent filter portion **68*b*** are connected to each other and have areas large enough to cover the light receiving surface of the first CCD **22**.

The motor drive circuit **69** is controlled by the system control circuit **10**, whereby the rollers **64** are rotated in such a manner that either the translucent opal filter portion **68*a*** or the transparent filter portion **68*b*** is located in front of the light receiving surface of the first CCD **22**.

The white balance adjustment is carried out by the system control circuit **10** in such a manner that the first CCD **22** is driven at a speed higher than a usual operation to pick up an image signal, after the translucent opal filter portion **68*a*** is positioned in front of the light receiving surface of the first CCD **22** by the motor drive circuit **69**.

On the other hand, for performing an AF adjustment, an output signal from the second CCD **23** is supplied to an AF control circuit **58**, in which the position of the taking lens **12** is obtained by a calculation so that the spatial frequency of an image formed on the second CCD **23** has the highest value. A drive signal corresponding to the lens position calculated by the AF control circuit **58** is outputted to the focus control circuit **15**, and thus the taking lens **12** is moved to the correct position. Note that the operation of the AF control circuit **58** is started when the shutter button **56** is depressed and the release switch is turned ON.

FIG. **3** shows a timing chart of the white balance adjustment, the AF adjustment and image recording operation.

When it is determined at time S1 that the release switch is turned ON, a white balance adjustment and an AF adjustment are started at the same time.

In the white balance adjustment process, the translucent opal filter portion **68*a*** is positioned in front of the first CCD **22**. Then, the first CCD **22** is operated by the CCD driver **26** under control of the system control circuit **10**, so that an output signal (an image signal) is read out from the first CCD **22** at a high speed. Namely, the synchronizing signal generating circuit **27** is controlled by the system control circuit **10** so that a high speed clock signal for controlling the CCD driver **26** is outputted by the synchronizing signal generating circuit **27**.

The output signal is inputted to the image process circuit **46** through the image memories **41** through **44**. In the image process circuit **46**, the three primary color signals, i.e., R, G and B signals, are generated in accordance with the input signal, and supplied to the white balance adjusting circuit **51** (FIG. **1**). In the system control circuit **10**, the ratios R/G and B/G are calculated based on the R, G and B signals, and white balance adjustment coefficients (amplification factors for the B and G signals) are obtained so that a proper white balance is obtained. In the white balance adjusting circuit **51**, the input signals are amplified in accordance with the white balance adjustment coefficients, and thus, a white balance adjustment process is performed.

On the other hand, in the AF adjustment, the second CCD **23** is operated by the CCD driver **26**, and the position of the

taking lens **12** is controlled in such a manner that the spatial frequency of an image signal obtained by the second CCD **23** has the highest value. Thus, the taking lens **12** is moved to an in-focus state.

As described above, in this embodiment, the white balance adjustment and the AF adjustment are started at the same time, but the white balance adjustment ends earlier than the AF adjustment. Thus, the white balance adjustment and the AF adjustment are carried out at substantially the same time.

When the white balance adjustment and the AF adjustment processes end, at time S2, the motor **67** of the filter drive device **63** is rotated in a direction shown by arrow A in FIG. **2**, and thus, the translucent opal filter portion **68***a* moves away from CCD **22**, and the transparent filter portion **68***b* is positioned in front of the CCD **22**.

Note that, in this embodiment, when the white balance adjustment is completed, the AF adjustment has also been completed. Therefore, the retreat of the translucent opal filter portion **68***a* from the CCD **22** is started when the AF adjustment has ended. However, the retreat of the translucent opal filter portion **68***a* can be started after the white balance adjustment is completed, even if the AF adjustment has not been completed.

Then, at time S3, an image recording operation is performed. Namely, the CCD driver **26** is controlled by the system control circuit **10**, so that any residual electric charge which has accumulated on the first and second CCDs **22** and **23** up to that time is discharged, and then, a real exposure of each of the CCDs **22** and **23** is carried out. After a predetermined time has passed, the accumulated electric charges on each of the CCDs **22** and **23** are transferred and the output signals of the CCDs **22** and **23** are picked up. The output signals of the CCDs **22** and **23** are subjected to predetermined processes in circuits such as the A/D converters **35** and **36** and the gamma correction circuit **52**, and thus, an image signal corresponding to the object is generated. The image signal is recorded to the IC memory card M, which is a recording medium, through the memory recording circuit **53**. After this recording operation, at time S4, the motor **67** of the filter drive circuit **63** is driven in a direction shown by arrow B in FIG. **2** for the next photographing operation, and the translucent opal filter portion **68***a* is again located in front of the CCD **22**.

As described above, in the embodiment, a translucent opal filter portion **68***a* is provided in the camera body of the still-video camera, and thus, before an image recording operation, when the shutter release is carried out, a white balance adjustment is performed using the CCD **22** while an AF adjustment is performed using the CCD **23**. Therefore, according to the embodiment, the time for attaching and detaching a translucent opal filter cap for a white balance adjustment, which must be carried out in a conventional device, is not required, and further, the white balance adjustment and the AF adjustment need not be carried out sequentially as in the conventional device. Accordingly, according to the embodiment, the time, from turning on the power supply of the still-video camera until an image can be recorded, is considerably shortened.

Further, according to the embodiment, since a white balance adjustment is performed at every shutter release operation, an operation in which an image is recorded without a white balance adjustment being performed is prevented.

Note that, although the embodiment is constructed in such a manner that an AF adjustment and a white balance adjustment are carried out immediately before a real exposure operation is performed, the AF adjustment, the white balance adjustment and a photometry measurement may be performed at the same time in synchronization with the photometry measurement which is carried out by a half-depression of a shutter button.

Further note that, although the translucent opal filter portion **68***a* is used as a color temperature sensing filter in the embodiment, a diffuser can be used for a white balance adjustment instead of the translucent opal filter portion **68***a*.

Still further note that, although the still-video camera is a dual-CCD-type having two CCDs **22** and **23** in the embodiment, the present invention can be applied to a triple-CCD-type still-video camera which has three CCDs transforming red, blue and green components to electric signals and which has a color temperature sensing filter provided on one the three CCDs.

Although the embodiments of the present invention have been described herein with reference to the accompanying drawings, obviously many modifications and changes may be made by those skilled in this art without departing from the scope of the invention.

The present disclosure relates to subject matter contained in Japanese Patent Application No. 5-245979 (filed on Sep. 6, 1993) which is expressly incorporated herein, by reference, in its entirety.

I claim:

1. A still video camera, comprising:

at least first and second imaging devices, a same image being formed on each of said at least first and second imaging devices;

a color temperature sensing filter device having an optical element selectively disposed in front of a light receiving surface of said first imaging device;

white balance adjusting means for carrying out a white balance adjustment in accordance with an output signal of said first imaging device when said first imaging device receives light through said optical element;

focusing means for moving a taking lens in accordance with an output signal of said second imaging device so that said taking lens moves to an in-focus state; and

means for combining said same images formed on each of said at least first and second imaging devices to form a frame color image,

said white balance adjusting means and said focusing means being carried out substantially at the same time.

2. A still-video camera according to claim **1**, said optical element comprising a translucent opal filter used for said white balance adjustment.

3. A still-video camera according to claim **1**, said optical element comprising a diffuser used for said white balance adjustment.

4. A still-video camera according to claim **1**, said color temperature sensing filter device comprising a pair of rollers disposed at both sides of said first imaging device, a filter film having a translucent opal filter portion and a transparent filter portion which are connected to each other and have areas large enough to cover said light receiving surface, said filter film being wound around said pair of rollers, and means for rotating said rollers in such a manner that one of said translucent opal filter portion and said transparent filter portion is located in front of said light receiving surface.

5. A still-video camera according to claim **1**, said focusing means moving said taking lens so that a spatial frequency of an image formed on said second imaging device has a highest value.

6. A still-video camera according to claim 1, said operation of said white balance adjusting means and said operation of said focusing means being started at the same time.

7. A still-video camera according to claim 1, said operation of said white balance adjusting means and said operation of said focusing means being started when a release switch is activated.

8. A still-video camera according to claim 1, further comprising:

means for controlling said color temperature sensing filter device in such a manner that said optical element moves away from said first imaging device after said white balance adjustment is completed.

9. A still-video camera according to claim 8, further comprising:

means for applying a predetermined process to signals outputted from said at least first and second imaging devices to generate an image signal corresponding to one frame; and

means for recording said image signal to a recording medium.

10. A still-video camera according to claim 1, said same image formed on said at least first and second imaging devices during a single photographing operation.

11. A still-video camera, comprising:

at least first and second imaging devices, a same image being formed on each of said first and second imaging devices;

a filter movable to cover a light receiving surface of said first imaging device and to move away from said light receiving surface;

means for carrying out a white balance adjustment in accordance with an output signal of said first imaging device when said filter covers said light receiving surface;

means for moving a taking lens in accordance with an output signal of said second imaging device so that said taking lens moves to an in-focus state, at least a part of said lens moving operation being carried out while said white balance adjustment is carried out; and

means for combining said same images formed on each of said at least first and second imaging devices to form a frame color image.

12. A still-video camera according to claim 11, said same image formed on said at least first and second imaging devices during a single photographing operation.

13. A still-video camera, comprising:

at least first and second imaging devices, a same image being formed on each of said first and second imaging devices;

a filter film comprising a translucent opal portion which can be positioned in front of a light receiving surface of said first imaging device;

means for winding said filter film in such a manner that said translucent opal portion covers said light receiving surface and moves away from said light receiving surface;

means for carrying out a white balance adjustment in accordance with an output signal of said first imaging device when said translucent opal portion is positioned in front of said light receiving surface; and

means for combining said same images formed on each of said at least first and second imaging devices to form a frame color image.

14. A still-video camera according to claim 13, said same image formed on said at least first and second imaging devices during a single photographing operation.

* * * * *

US005995142A

United States Patent [19]

Matsufune

[11] **Patent Number: 5,995,142**

[45] **Date of Patent: Nov. 30, 1999**

[54] **AUTOMATIC WHITE BALANCE CONTROL SYSTEM FOR A COLOR VIDEO CAMERA**

[75] Inventor: **Isao Matsufune**, Kanagawa, Japan

[73] Assignee: **Sony Corporation**, Tokyo, Japan

[21] Appl. No.: **08/828,532**

[22] Filed: **Mar. 31, 1997**

[30] **Foreign Application Priority Data**

Feb. 4, 1996	[JP]	Japan	8-102041
Mar. 2, 1997	[JP]	Japan	9-032571

[51] **Int. Cl.**[6] **H04N 9/73**

[52] **U.S. Cl.** **348/223**; 348/225; 348/655

[58] **Field of Search** 348/223, 224, 348/225, 655; 358/516

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,797,733	1/1989	Takagi et al.	348/223
4,911,552	3/1990	Kurashige et al. .	
5,099,316	3/1992	Ogawa .	
5,146,316	9/1992	Suzuki	348/223
5,182,636	1/1993	Kikuchi et al. .	
5,267,026	11/1993	Kawahara et al. .	
5,272,521	12/1993	Tatsumi	348/223
5,319,449	6/1994	Saito et al.	348/223
5,442,409	8/1995	Haruki et al.	348/655
5,448,292	9/1995	Matsui et al.	348/225
5,563,656	10/1996	Kyuma	348/223
5,644,359	7/1997	Ito	348/223
5,654,753	8/1997	Takei	348/223

FOREIGN PATENT DOCUMENTS

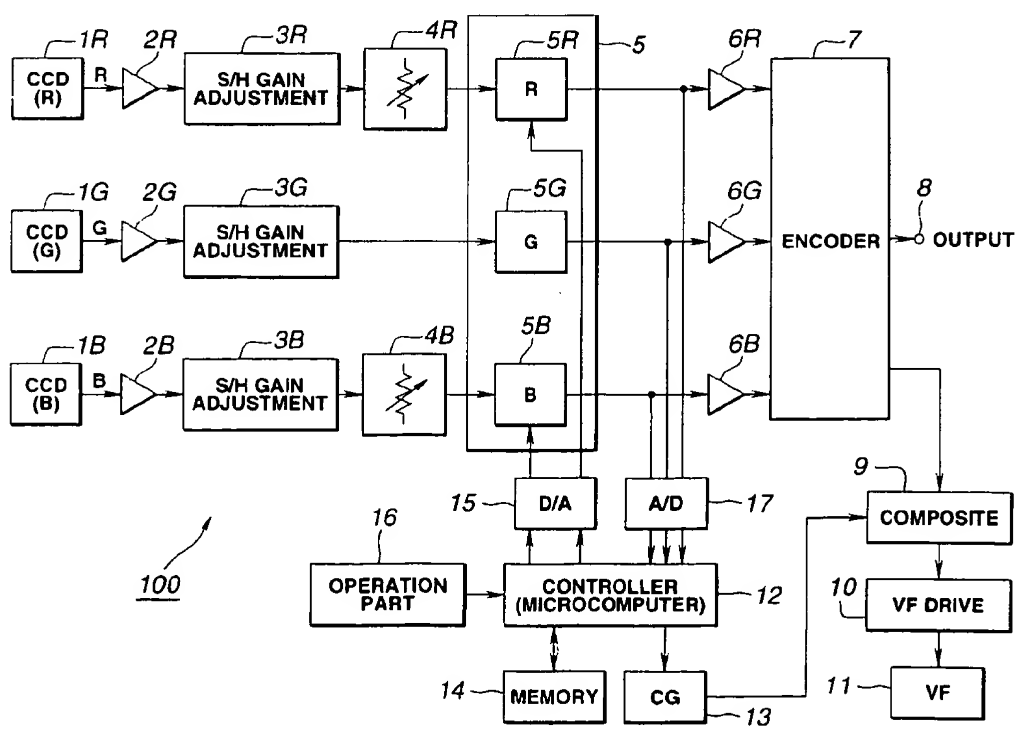
0400606	12/1990	European Pat. Off. .
0663779	7/1995	European Pat. Off. .
2-194792	8/1990	Japan .

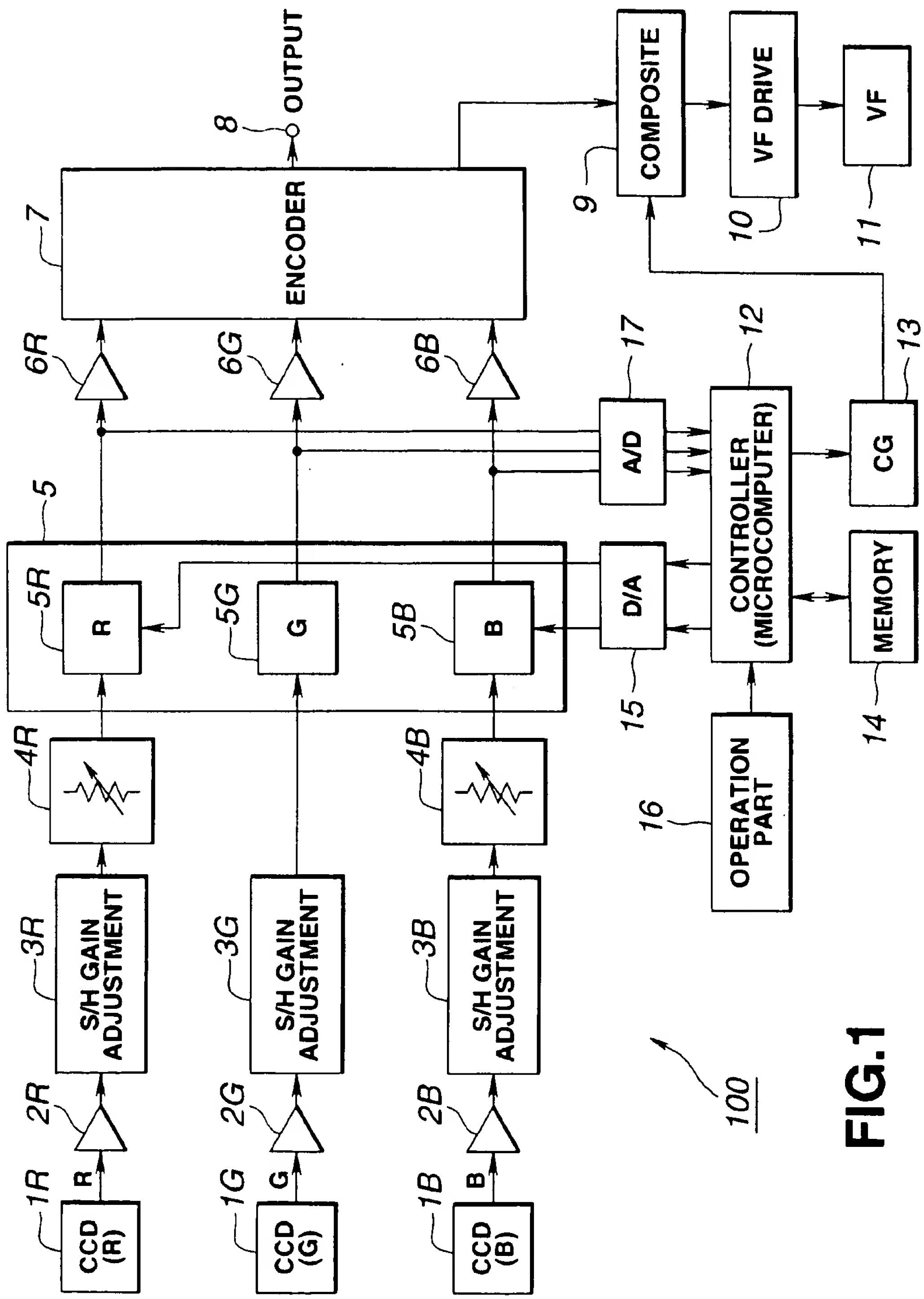
Primary Examiner—Tuan Ho
Assistant Examiner—Luong Nguyen
Attorney, Agent, or Firm—Frommer Lawrence & Haug, LLP.; William S. Frommer

[57] **ABSTRACT**

An imaging device includes an imaging device for converting an image into a plurality of color signals each having a signal level; a white balance amplifier for adjusting the signal level of at least one color signal to produce a plurality of amplified color signals; a calibration device for calibrating the white balance amplifier and for producing at least one calibration parameter; a detecting device for detecting the amplified color signals; a calculation device for calculating at least one white balance amplification adjustment as a function of the plurality of amplified color signals; a comparing device for comparing at least one white balance amplification adjustment with at least one calibration parameter; and an automatic adjustment device for automatically adjusting the white balance amplifier to amplify the signal level of at least one of the plurality of color signals if at least one white balance amplification adjustment is consistent with at least one calibration parameter.

24 Claims, 9 Drawing Sheets





CCD (R)
CCD (G)
CCD (B)
S/H GAIN ADJUSTMENT
ENCODER
OUTPUT
COMPOSITE
VF DRIVE
VF
A/D
D/A
CONTROLLER (MICROCOMPUTER)
CG
MEMORY
OPERATION PART
100

FIG.1

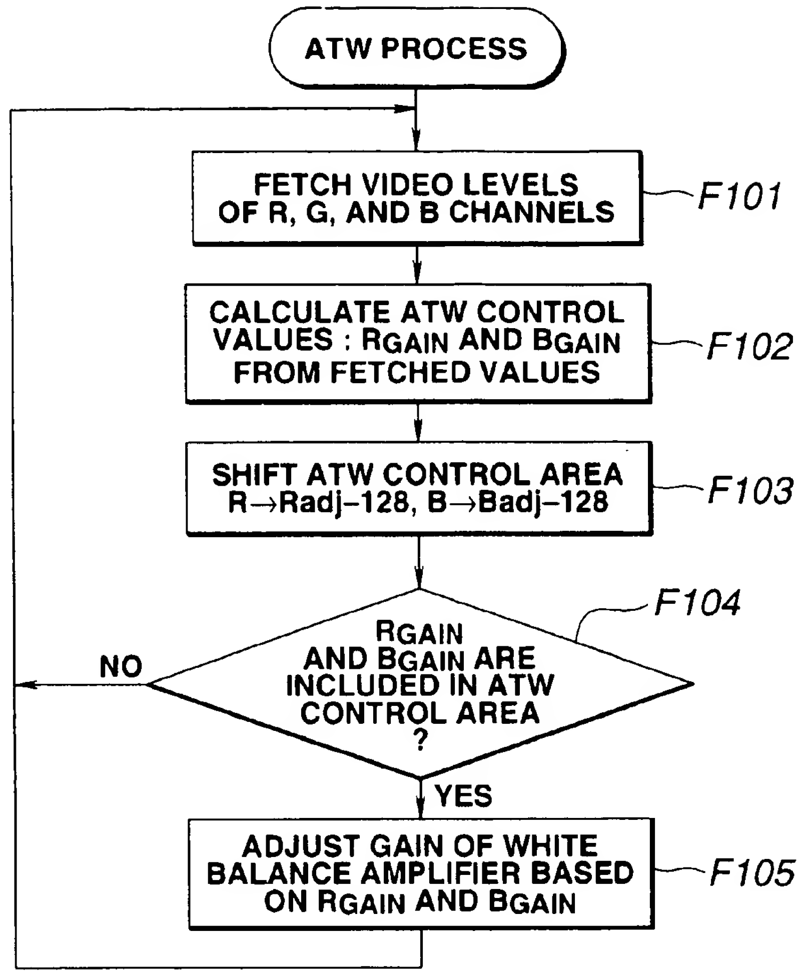

ATW PROCESS
FETCH VIDEO LEVELS OF R, G, AND B CHANNELS
F101
CALCULATE ATW CONTROL VALUES : RGAIN AND BGAIN FROM FETCHED VALUES
F102
SHIFT ATW CONTROL AREA R→Radj−128, B→Badj−128
F103
RGAIN AND BGAIN ARE INCLUDED IN ATW CONTROL AREA ?
F104
NO
YES
ADJUST GAIN OF WHITE BALANCE AMPLIFIER BASED ON RGAIN AND BGAIN
F105

FIG.2

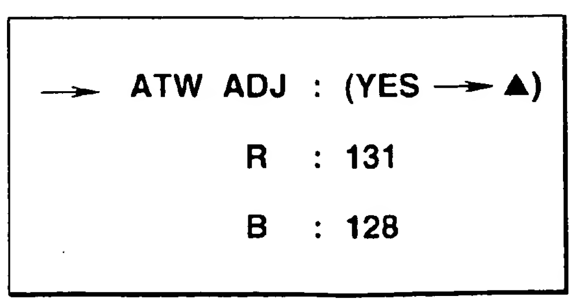

ATW ADJ : (YES → ▲)
R : 131
B : 128

FIG.3

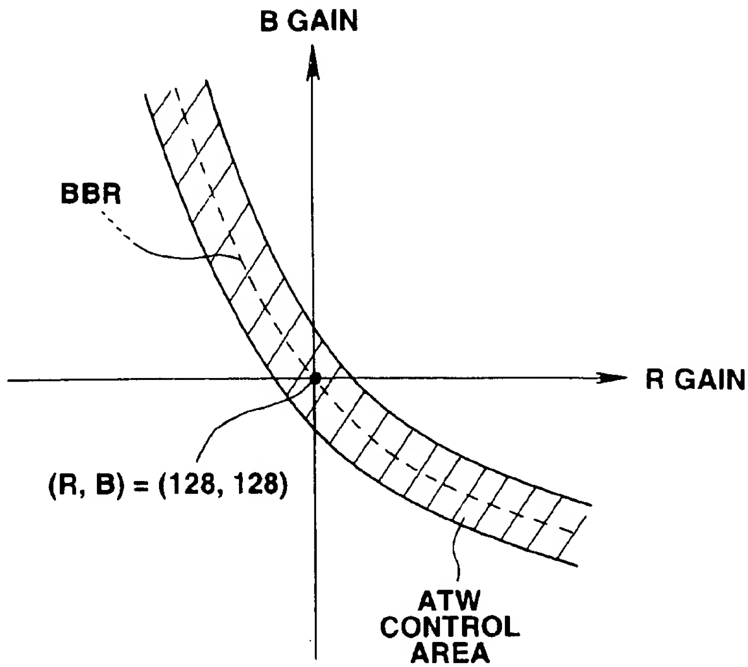

B GAIN
BBR
R GAIN
(R, B) = (128, 128)
ATW
CONTROL
AREA

FIG.4(a)

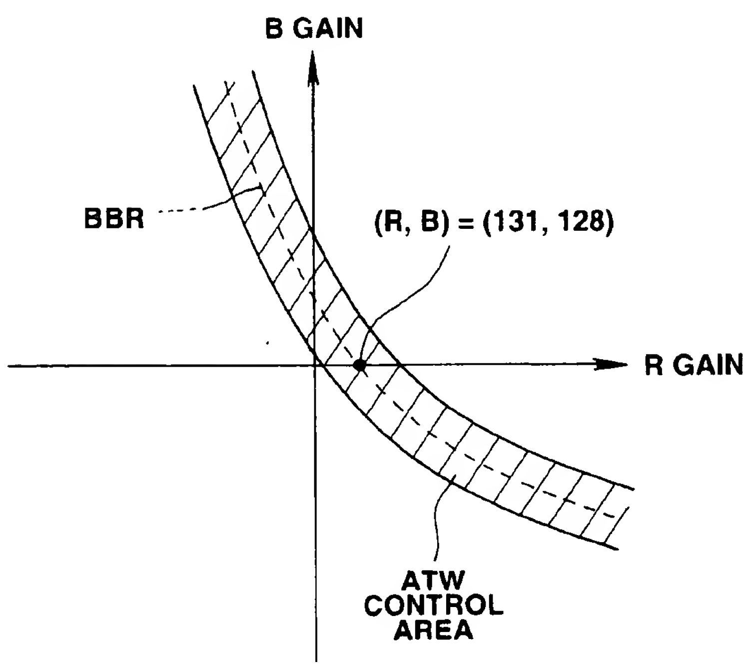

B GAIN
BBR
(R, B) = (131, 128)
R GAIN
ATW
CONTROL
AREA

FIG.4(b)

FIG.5(a)

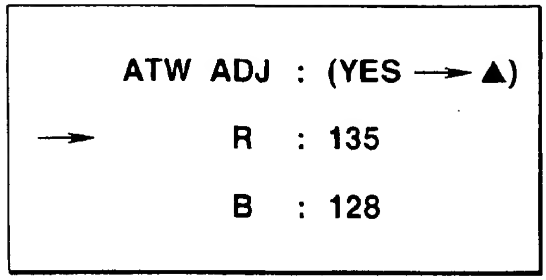
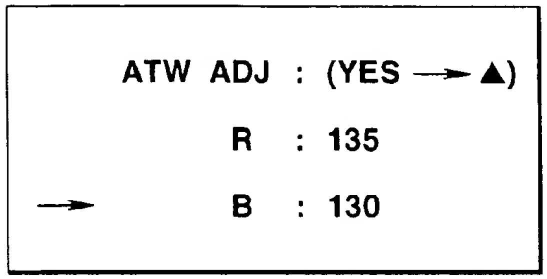


FIG.5(b)



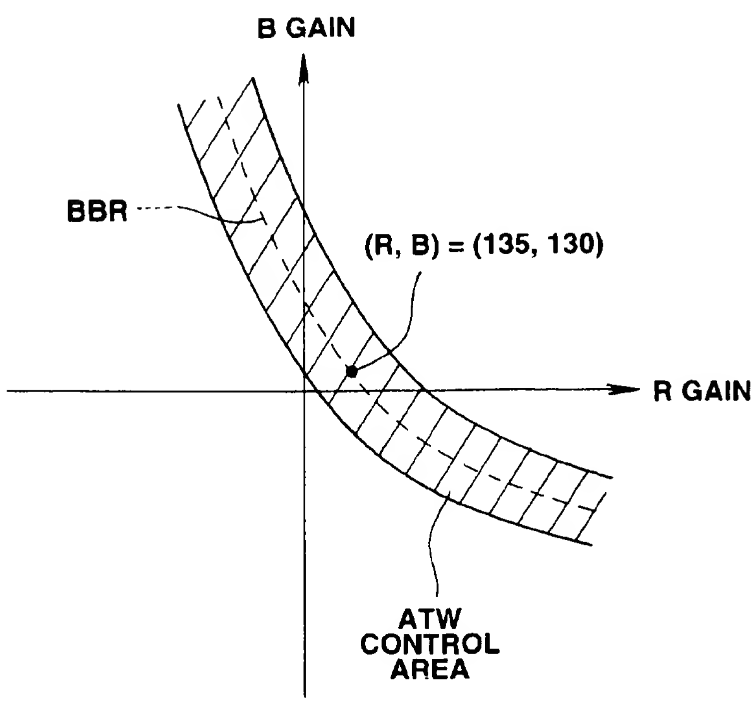


FIG.6

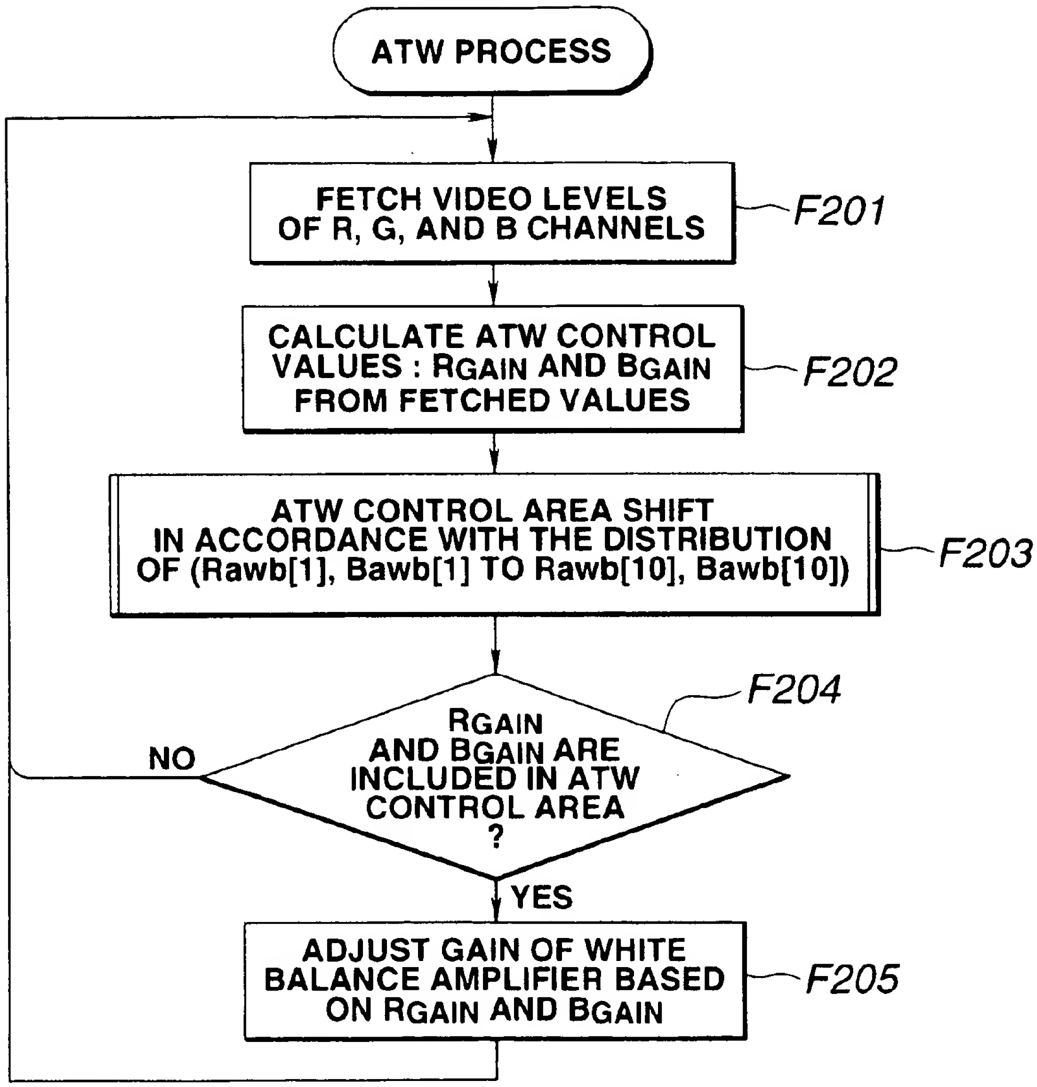

ATW PROCESS
FETCH VIDEO LEVELS OF R, G, AND B CHANNELS
F201
CALCULATE ATW CONTROL VALUES : RGAIN AND BGAIN FROM FETCHED VALUES
F202
ATW CONTROL AREA SHIFT IN ACCORDANCE WITH THE DISTRIBUTION OF (Rawb[1], Bawb[1] TO Rawb[10], Bawb[10])
F203
RGAIN AND BGAIN ARE INCLUDED IN ATW CONTROL AREA ?
F204
NO
YES
ADJUST GAIN OF WHITE BALANCE AMPLIFIER BASED ON RGAIN AND BGAIN
F205

FIG.7

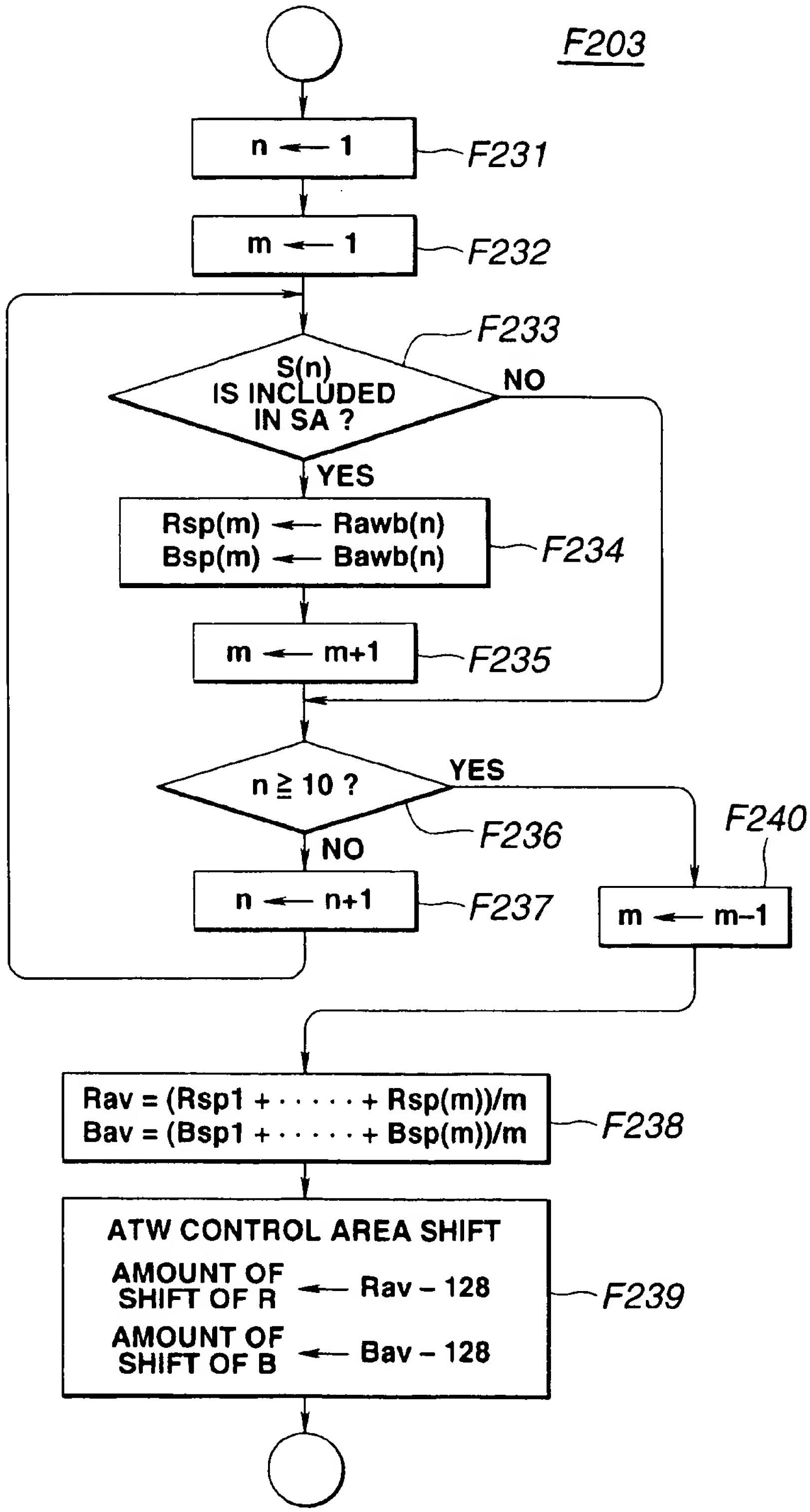

F203
n ← 1
F231
m ← 1
F232
F233
S(n) IS INCLUDED IN SA ?
NO
YES
Rsp(m) ← Rawb(n)
Bsp(m) ← Bawb(n)
F234
m ← m+1
F235
n ≧ 10 ?
YES
F236
NO
n ← n+1
F237
F240
m ← m-1
Rav = (Rsp1 + · · · · · + Rsp(m))/m
Bav = (Bsp1 + · · · · · + Bsp(m))/m
F238
ATW CONTROL AREA SHIFT
AMOUNT OF SHIFT OF R ← Rav - 128
AMOUNT OF SHIFT OF B ← Bav - 128
F239

FIG.8

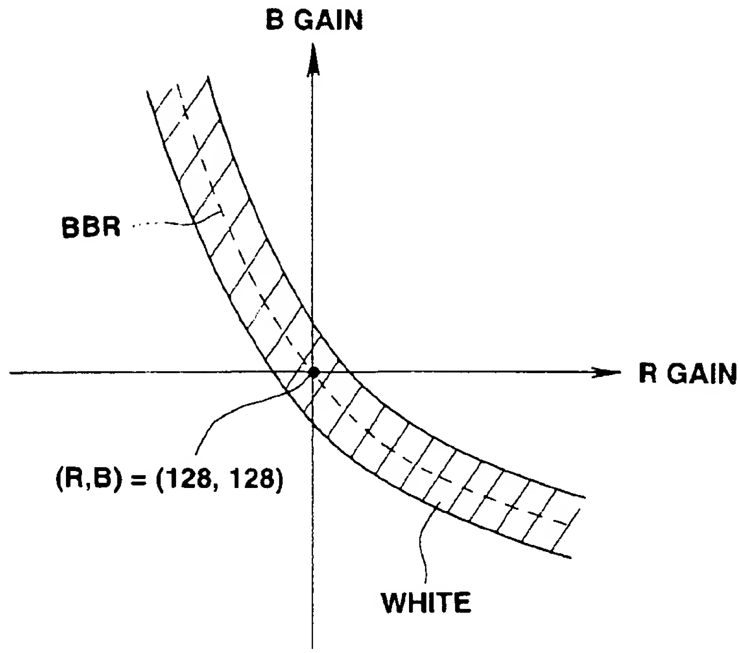

B GAIN
BBR
R GAIN
(R,B) = (128, 128)
WHITE

FIG.9

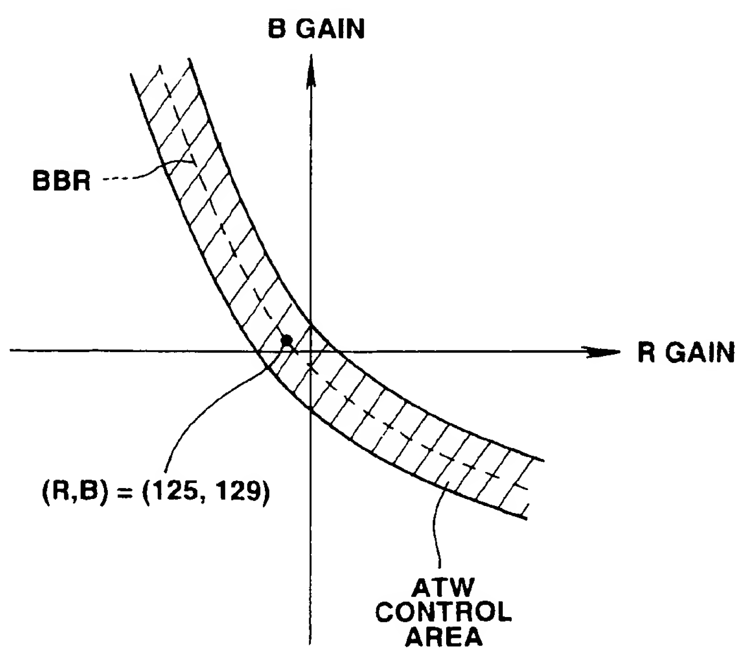

B GAIN
BBR
R GAIN
(R,B) = (125, 129)
ATW
CONTROL
AREA

FIG.10(a)

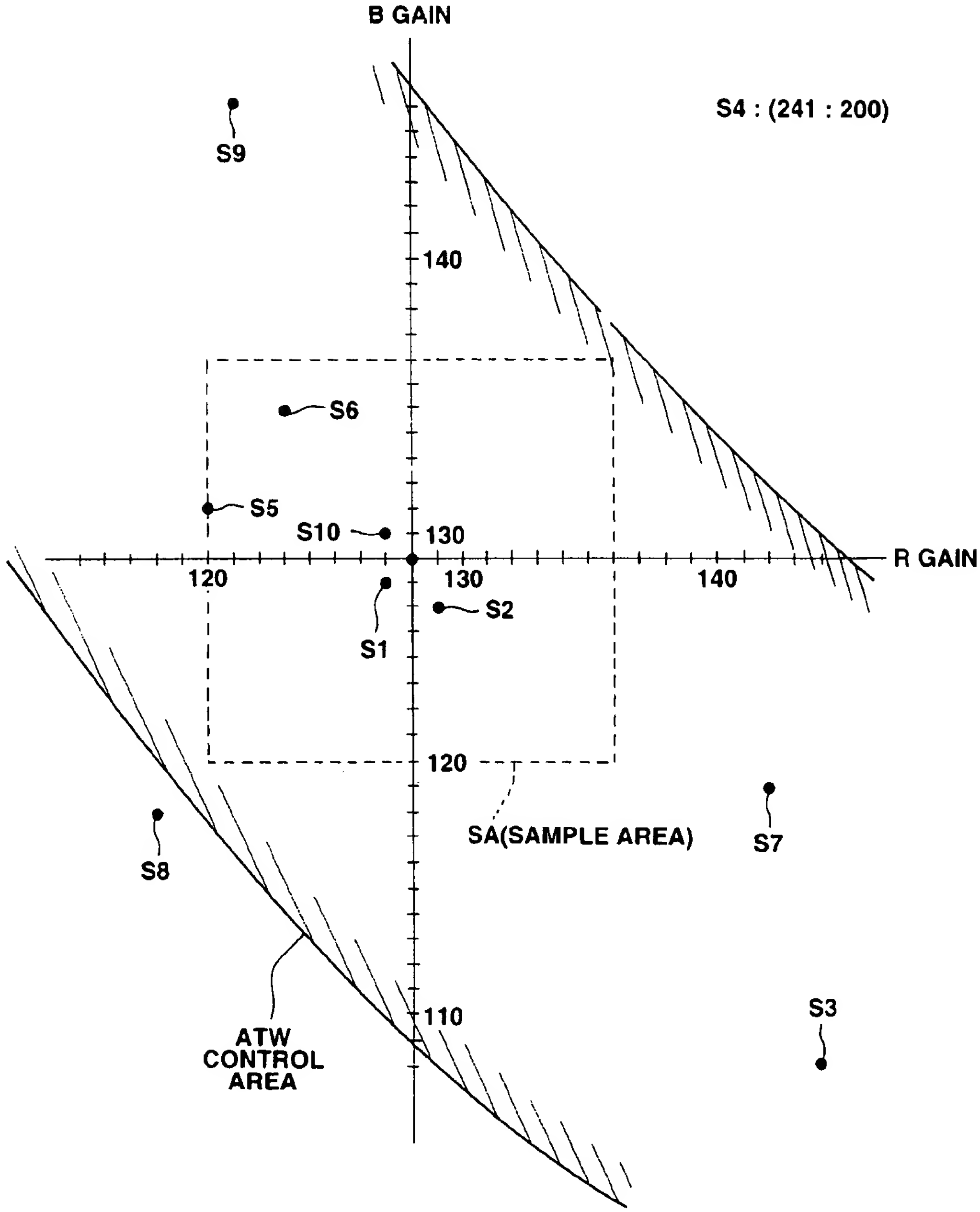

B GAIN
S4 : (241 : 200)
S9
140
S6
S5
S10
130
120
130
140
R GAIN
S1
S2
120
SA(SAMPLE AREA)
S7
S8
110
S3
ATW
CONTROL
AREA

FIG.10(b)

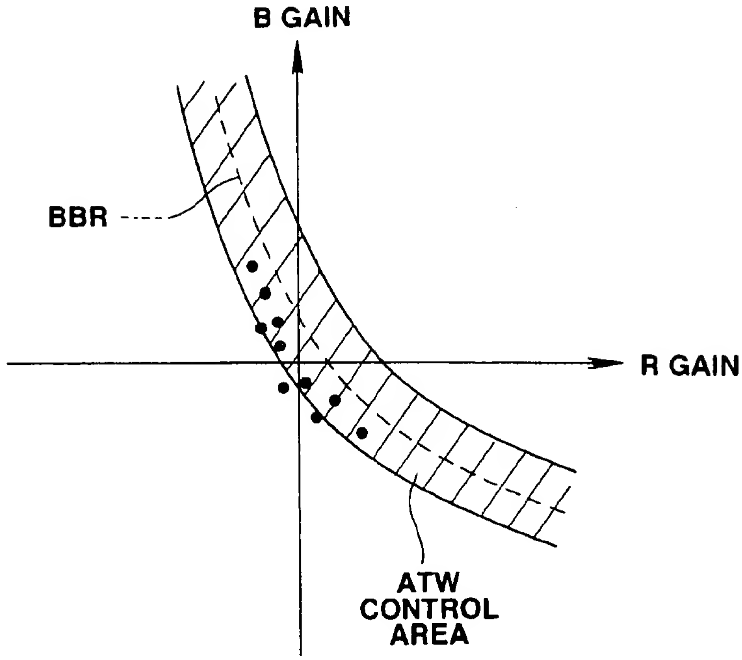


FIG.11(a)

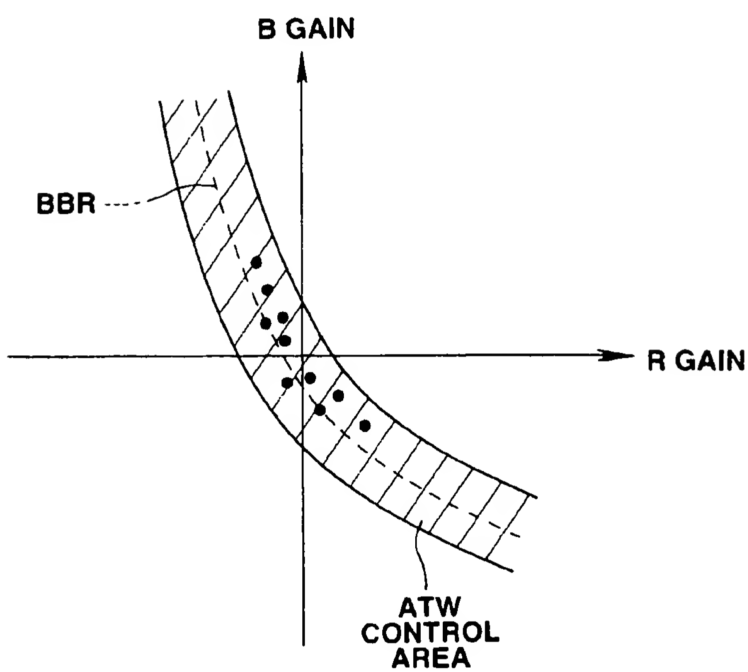


FIG.11(b)

AUTOMATIC WHITE BALANCE CONTROL SYSTEM FOR A COLOR VIDEO CAMERA

BACKGROUND OF THE INVENTION

In a color video camera, white balance is achieved when a neutral white object imaged by the camera under given illumination is represented as red (R), green (G), and blue (B) signals having equal output levels. White balance is needed since the RGB representation produced by a color video camera typically changes as the illumination of a scene varies. In some circumstances, a color video camera white balanced for certain illumination conditions will not be white balanced for other illumination conditions. As a result, it is possible that an object under two different illuminations will have two different RGB representations even though a human observer would perceive the object as having the same color under both illuminations.

In a manual operation, white balance is achieved by imaging a neutral white object under the illumination of interest and adjusting the amplification of one or more of the red, green, and blue signals until their respective output levels are equal. In an automatic white balance (AWB) operation, a neutral white object under the illumination of interest is imaged and the amplification levels of each of the red and blue signals are adjusted. For example, the output levels of the red and blue signals may be made equal to that of the green signal. In both operations, maintenance of white balance will depend upon the consistency of the illumination conditions and maintenance of the adjusted amplification levels.

In an automatic tracing white balance (ATW) operation, the white balance operation is automatically repeatedly carried out during an ordinary imaging process. Since an ordinary imaged scene may not contain a neutral white object, it is possible that the white balance will be incorrectly adjusted with reference to a colored object. Consequently, true white balance may not be achieved, e.g. a non-white color is represented as the color white.

FIG. 9 illustrates a black body radiation curve BBR, plotted on red signal gain vs. blue signal gain axes relative to red and blue signal amplifiers in a video camera. As shown, signal gain values are represented by eight-bits and, accordingly, each axis extends from 0 to 256. The red signal gain and blue signal gain axes intersect at the point (128, 128). Also illustrated is a white area, indicated by slanted lining, which is generally symmetric about the black body radiation curve BBR. The white area represents red and blue signal values which are characteristic of the color white.

To avoid the problem of incorrect white balance adjustment during an ATW operation, the red and blue signal values representing an imaged scene may be compared to a predetermined set of red and blue signal values characteristic of the color white. The white area comprises such a set of red and blue signal values characteristic of the color white.

Previously, it was attempted to manually calibrate the white area such that output levels of the respective R, G, and B signals are mutually equal when a reference light source is imaged. With reference to FIG. 9, calibration with respect to a standard light source would be attained when the B signal gain and the R signal gain are both equal to 128.

In practice, a variable resistance was provided to manually adjust white balance amplification while a standard light source was imaged. A manual adjustment was made of the R signal and B signal output levels to make them equal to the G signal output level. Since the adjustment was made manually by a user or technician, errors in calibration have occurred and a precise adjustment has been difficult to achieve. Miscalibration introduces error into the ATW operation, reducing its effectiveness. Additionally, the introduction of manual adjustment error may significantly limit further improvement in ATW processing efforts. Further error is introduced if the setting of the variable resistance shifts after a manual adjustment. Repeated manual readjustment can be difficult.

OBJECTS AND SUMMARY OF THE INVENTION

Therefore, an object of the present invention is to provide apparatus and methodology for an improved white balance operation.

Another object of the present invention is to provide an automatic white balance operation and an automatic tracing white balance operation with improved accuracy and precision.

Still another object of the present invention is to provide an adaptive automatic tracing white balance operation for precisely adjusting white balance based upon the results of previous automatic white balance operations.

According to an aspect of the present invention, an imaging device is provided which includes an imaging device that converts an image into a plurality of color signals each having a signal level; a white balance amplifier that adjusts the signal level of at least one of the color signals to produce a plurality of amplified color signals; a calibration device that calibrates the white balance amplifier and produces at least one calibration parameter; a detecting device that detects the amplified color signals; a calculation device that calculates at least one white balance amplification adjustment as a function of the amplified color signals; a comparing device that compares at least one white balance amplification adjustment with at least one calibration parameter; and an automatic adjustment device that automatically adjusts the white balance amplifier to amplify the signal level of at least one color signal if at least one white balance amplification adjustment is consistent with at least one calibration parameter.

According to another aspect of the present invention, an imaging device is provided which includes an imaging device for converting an image into a plurality of color signals each having a signal level; a white balance amplifier that adjusts the signal level of at least one color signal to produce a plurality of amplified color signals; a calibration device for repeatedly calibrating the white balance amplifier and for producing a plurality of calibration parameters; a detecting device that detects the amplified color signals; a first calculation device that calculates at least one white balance amplification adjustment as a function of the amplified color signals; a storage device that stores the calibration parameters; a second calculation device that retrieves the calibration parameters from the storage means and that calculates an overall calibration factor as a function of the plurality of calibration parameters; a comparing device that compares at least one white balance amplification adjustment with the overall calibration parameter; and an automatic adjustment device for automatically adjusting the white balance amplifier to amplify the signal level of at least one of the color signals if at least one white balance amplification adjustment is consistent with the overall calibration parameter.

Other objects, features, and advantages according to the present invention will become apparent from the following

detailed description of illustrated embodiments when read in conjunction with the accompanying drawings in which the same components are identified by the same reference numerals.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of an image recorder according to an embodiment of the present invention;

FIG. 2 is flow chart to which reference will be made in describing the operation of an image recorder according to the present invention;

FIG. 3 is a menu display diagram;

FIGS. 4(*a*) and 4(*b*) are diagrams of gain values;

FIGS. 5(*a*) and 5(*b*) are menu display diagrams;

FIG. 6 is a diagram of gain values;

FIG. 7 is flow chart to which reference will be made in describing another operation of an image recorder according to the present invention;

FIG. 8 is a flow chart to which reference will be made in describing a step from the flow chart of FIG. 7;

FIG. 9 is a diagram of gain values;

FIGS. 10(*a*) and 10(*b*) are diagrams of gain values; and

FIGS. 11(*a*) and 11(*b*) are diagrams of gain values.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates an imaging device **100** according to an embodiment of the present invention. Imaging device **100** includes charge-coupled devices (CCD) 1R, 1G, and 1B; preamplifiers 2R, 2G, and 2B; sample/hold gain control circuits 3R, 3G, and 3B; variable resistors 4R and 4B; white balance amplifier 5; amplifiers 6R, 6G, and 6B; encoder 7; composite circuit 9, view finder driver **10**, view finder **11**, controller **12**, character generator **13**, memory device **14**, digital-to-analog (D/A) converter **15**, operation circuit **16**; and analog-to-digital (A/D) converter **17**.

CCD **1R**, CCD **1G**, and CCD **1B** are conventional primary color image pick-up devices for imaging incident red, green, and blue light, respectively. CCD **1R** produces a red signal R, CCD **1G** produces a green signal G, and CCD **1B** produces a blue signal B which are transmitted to respective pre-amplifiers 2R, 2G, and 2B. Pre-amplifiers 2R, 2G, and **2B** are conventional pre-amplifier devices for amplifying input signals.

Pre-amplifiers 2R, 2G, and **2B** output amplified R, G, and B signals to respective sample/hold gain control circuits **3R**, 3G, and 3B. Sample/hold gain control circuits 3R, 3G, and **3B** sample and hold input signals in a conventional manner and pre-process the input image signals. For example, such pre-processing may include gain control, flare processing, pre-knee compensation, or the like.

Pre-processed R and B signals from sample/hold gain control circuits **3R** and **3B** are supplied to respective variable resistors **4R** and **4B**. Variable resistors **4R** and **4B** are variable resistance elements for further adjusting the pre-processed R and B signals, respectively. Variable resistors **4R** and **4B** are utilized to adjust the levels of pre-processed R and B signals to achieve a white balance operation.

White balance amplifier **5** is comprised of variable-gain amplifiers **5R** and **5B**, along with amplifier **5G**. Each of variable-gain amplifiers **5R** and **5B** are conventional variable-gain amplifiers, while amplifier **5G** is a conventional amplifier. Variable-gain amplifier **5R** amplifies the signal supplied from variable resistor **4R** to produce an amplified R signal which is supplied to amplifier **6R**. Variable-gain amplifier **5B** amplifies the signal supplied from variable resistor **4B** to produce an amplified B signal which is supplied to amplifier **6B**. Amplifier **5G** amplifies the pre-processed G signal supplied from sample/hold gain control circuit **3G** to produce an amplified G signal which is supplied to amplifier **6G**.

As a practical example, a white balance operation could be achieved by imaging a reference light source, setting the gains of variable-gain amplifiers **5R** and **5B** at intermediate values, and then adjusting variable resistors **4R** and **4B** such that the outputs of amplifier **5** are equal. However, in the present embodiment, primarily variable-gain amplifiers **5R** and **5B** are utilized to achieve the white balance operation.

Amplifiers **6R**, **6G**, and **6B** are conventional amplifier devices which further amplify the amplified R, G, and B signals input respectively thereto, and which output further amplified R, G, and B signals to encoder **7**.

The amplified R, G, and B signals are also supplied to A/D converter **17**. A/D converter **17** is a conventional analog-to-digital conversion device. A/D converter **17** converts the amplified R, G, and B signals to digital R, G, and B signals, respectively, which are supplied to controller **12**.

Controller **12** is a conventional controller device, preferably a conventional microprocessor device, which operates to control imaging device **100**. Controller **12** is, in turn, responsive to control signals provided by operation circuit **16**. Alternatively, operation circuit **16** stores software programs which are accessed by and implemented within controller **12** to direct the operation of controller **12**. Operation circuit **16** is preferably a source of control signals. Alternatively, operation circuit **16** is a memory device which stores software programs for directing the operation of controller **12**. Controller **12** utilizes memory **14**, a conventional data storage device, in performing its control operations. Memory **14** may store parameter data, such as gain control values, for an AWB operation by controller **12**, provide temporary data storage for controller **12** during computations and other processing, and perform additional similar activities.

Encoder **7** is a conventional signal processing and encoding device. Encoder **7** may process the further amplified R, G, and B signals output by amplifiers **6R**, **6G**, and **6B** to achieve gamma correction, knee correction, or the like. The input signals are then matrix processed to produce a brightness signal Y and color difference signals R-Y and B-Y. Further, the brightness signal and the color difference signals are encoded by an NTSC encoding process to produce a color composite video signal in accordance with the NTSC standard. The color composite video signal is output at output terminal **8**. The brightness signal and the color difference signals, or alternatively, corresponding image signals of another form, are also supplied to composite circuit **9**.

Character generator **13** is a conventional character generation device for generating character image signals in response to character commands from controller **12**. Character generator **13** supplies character image signals to composite circuit **9**. Composite circuit **9** is a composition device for superimposing character image signals from character generator **13** onto image signals from encoder **7** to produce a composite signal.

The composite signal is supplied to view finder driver **10**, a conventional view finder driving device. View finder driver **10** drives view finder **11** to display an image corresponding to the composite signal to a user. View finder **11** is a conventional view finder-type display device.

Controller 12 detects the respective signal levels of the amplified R, G, and B signals and controls imaging device 100 to achieve both AWB and ATW operations to produce an improved white balance control. In operation, as a function of the respective signal levels of the amplified R, G, and B signals, controller 12 adjusts the respective gains of variable-gain amplifiers 5R and 5B. Specifically, controller 12 supplies digital gain control signals to D/A converter 15, a conventional digital-to-analog conversion device, which converts the digital signals to analog form. The analog signals are supplied to variable-gain amplifiers 5R and 5B to control their amplification. Thus, A/D converter 17, controller 12, and D/A converter 15 comprise a feedback control system for controlling amplifier 5.

To display information, such as operational state information, display mode, and the like, to a user, controller 12 supplies character commands corresponding to such information to character generator 13. Character generator 13 generates character image signals corresponding to the supplied character commands and outputs such signals to composite circuit 9. Composite circuit 9 superimposes the character image signals on image signals supplied from encoder 7 to produce a composite signal for output to view finder driver 10. View finder driver 10 drives view finder 11 to display the composite signal to the user. Accordingly, the user may monitor the imaged scene and the effect of the white balance processing, and view informative text.

In an AWB operation, controller 12 monitors the signal levels of the amplified R, G, and B signals while a white reference object is imaged. Controller 12 then calculates the amplification amount (gain) needed to equalize each of the amplified R and B signals with the amplified G signal. Corresponding gain control signals are supplied by controller 12, through D/A converter 15, to variable-gain amplifiers 5R and 5B, respectively. In this manner, each of variable-gain amplifiers 5R and 5B are independently adjusted by controller 12 and white balance is achieved at the outputs of amplifier 5.

In an ATW operation, controller 12 consults a predetermined set of red and blue signal values characteristic of the color white. FIGS. 4(*a*) and 4(*b*) illustrate an ATW control area which comprises such a set of red and blue signal values characteristic of the color white, along with a black body radiation curve BBR. As shown, the ATW control area, indicated by slanted lining, is preferably symmetric about black body radiation curve BBR.

The ATW control area and the curve BBR are plotted on red signal gain vs. blue signal gain axes relative to the respective gains of variable-gain amplifiers 5R and 5B. Signal gain values are represented by eight-bits and, accordingly, each axis extends from 0 to 256. The red signal gain and blue signal gain axes intersect at the point (128, 128). Preferably, the ATW control area is centered at the point (128,128), as shown in FIG. 4(*a*), which would correspond to a color temperature of 3200K.

To initially calibrate the ATW control area an AWB operation is executed, preferably during the manufacturing process. A standard light source is imaged by CCD's 1R, 1G, and 1B. The corresponding R, G, and B signals are transmitted to pre-amplifiers 2R, 2G, and 2B, respectively, which amplify the respective signals. Sample/hold gain control circuits 3R, 3G, and 3B sample and hold the pre-amplified R, G, and B signals, respectively, and pre-process the resulting signals to produce pre-processed R, G, and B signals, respectively.

The pre-processed R and B signals are supplied to variable resistors 4R and 4B, respectively. Preferably, variable resistors 4R and 4B are initially set in a fixed, e.g. constant resistance, state. Variable resistors 4R and 4B adjust the respective levels of the pre-processed R and B signals and supply the adjusted R and B signals to variable-gain amplifiers 5R and 5B, respectively. The pre-processed G signal is supplied to variable-gain amplifier 5G.

Variable-gain amplifiers 5R, 5G, and 5B provide an initial amount of amplification to each of the input R, G, and B signals to produce amplified R, G, and B signals, respectively. Controller 12, through A/D converter 17, detects the output levels of the amplified R, G, and B signals and calculates the gain adjustments needed by variable-amplifiers 5R and 5B, respectively, to equalize the amplified R and B signals with the amplified G signal. Controller 12 stores the gain adjustment values in memory 14 and supplies corresponding gain control signals to variable-amplifiers 5R and 5B through D/A converter 15. The respective amplification levels of variable-amplifiers 5R and 5B are adjusted accordingly.

It is noted that the above-described AWB operation implements a feedback loop which omits any adjustment of variable resistors 4R and 4B. Preferably, variable resistors are retained for other adjustment operations. Optionally, the variable resistors may be omitted entirely. Alternatively, variable resistors 4R and 4B may be utilized to coarsely adjust the signal levels of the R and B signals input to amplifier 5, after which the feedback loop is utilized to achieve precise white balance calibration.

Following calibration of the ATW control area, an ATW operation can be executed. As will be described below, the gain adjustment values calculated in a preceding AWB operation are utilized during the ATW operation to calibrate the ATW control area prior to ATW processing. The AWB operation may be an initial AWB operation executed during the manufacturing of imaging device 100 or may be a subsequent AWB operation executed by a user.

In an ATW operation, preferably, controller 12 issues to character generator 13 character commands corresponding to a menu of user functions. Character generator 13 generates character image signals corresponding to the menu and outputs such signals to composite circuit 9. Composite circuit 9 superimposes the menu on image signals supplied from encoder 7 to produce a composite signal for output to view finder driver 10. View finder driver 10 drives view finder 11 to display the composite signal which includes the menu to the user.

FIG. 3 illustrates a preferred ATW operation menu. As shown, the user is displayed a prompt to initiate an ATW adjustment operation ("ATW ADJ"). When the ATW adjustment operation is selected by the user, the R and B signal gain adjustments calculated by controller 12 in a preceding AWB operation are then displayed and stored by controller 12 in memory 14 as signal gain adjustments Radj and Badj, respectively. Optionally, the R and B signal gain adjustments are initially displayed along with the ATW adjustment operation prompt. In this manner, subsequent AWB operations may be utilized to update stored Radj and Badj values.

Preferably, the user's selection of the ATW adjustment operation is entered via a user interface portion of operation circuit 16. Operation circuit 16 transmits the user's selection to controller 12 which initiates the ATW adjustment operation accordingly. The ATW adjustment operation may be carried out repeatedly by a user as needed.

FIG. 2 illustrates an ATW adjustment operation method according to an embodiment of the present invention. In step F101, controller 12 detects the output signal levels of the

amplified R, G, and B signals via A/D converter **17**, and processing proceeds with step **F102**. In step **F102**, controller **12** calculates the gain adjustments, R_{GAIN} and B_{GAIN}, needed by variable-amplifiers **5R** and **5B**, respectively, to equalize the amplified R and B signals with the amplified G signal, and processing proceeds with step **F103**.

In step **F103**, an offset for the ATW control area is calculated by subtracting the ideal intermediate amplification value, e.g. 128 in the present example, from each of the stored signal gain adjustments Radj and Badj. As an example, utilizing sample Radj and Badj values from FIG. **3**, Radj=131 and Badj=128, an R gain offset of 3 (=131−128) and a B gain offset of 0 (=128−128) can be calculated. Controller **12** corrects (shifts) the ATW control area by an amount equal to the calculated R gain offset and B gain offset values. Further to the above example, correction of the ATW control area of FIG. **4**(*a*) is achieved by shifting the ATW control area by three R gain units and zero B gain units as shown in FIG. **4**(*b*). Of course, the ATW control area may be shifted along the Rgain axis, the Bgain axis, or both depending on the calculated offset values. Processing proceeds with step **F104**.

In step **F104**, the gain adjustments, R_{GAIN} and B_{GAIN}, calculated by controller **12** are compared by controller **12** to the corrected ATW control area. If either R_{GAIN} or B_{GAIN} is outside the corrected ATW control area, i.e. represent values not included among the set of values represented by the ATW control area, then controller **12** determines that the present corresponding image is not suitable for use in white balance adjustment, amplifiers **5R** and **5B** are not adjusted, and processing returns to step **F101**. If both R_{GAIN} and B_{GAIN} are within the corrected ATW control area, i.e. represent values included among the set of values represented by the ATW control area, then controller 12 determines that the present corresponding image is suitable for use in white balance adjustment and processing proceeds with step **F105**.

In step **F105**, controller **12** supplies gain control signals corresponding to the R_{GAIN} and B_{GAIN} values through D/A converter **15** to variable-gain amplifiers **5R** and **5B**, respectively. In this manner white balance is achieved. The white balanced signals are amplified by amplifiers **6R**, **6G**, and **6B**, encoded by encoder **7**, and output at output terminal **8**.

In an alternate ATW operation, variation in the reference light source used for white balance calibration can be accommodated by manual adjustment of the ATW control area. Variation in the reference light source may be measured by a user with a color chromaticity system and the resulting measurements converted into corresponding signal gain adjustment values, Radj and Badj for correction (shift) of the ATW control area.

FIGS. **5**(*a*) and **5**(*b*) illustrate an alternative ATW operation menu. As in the menu of FIG. **3**, the user is displayed a prompt to initiate an ATW adjustment operation ("ATW ADJ") along with the R and B signal gain adjustments calculated by controller **12** in a preceding AWB operation. Additionally, the user is prompted to modify, if desired, the displayed R and B signal gain adjustment values. The user enters a desired modification via the user interface portion of operation circuit **16**. FIG. **5**(*a*) shows a user's modification of the R signal gain adjustment value to 135 and FIG. **5**(*b*) shows a user's modification of the B signal gain adjustment value to 130. The modified R and B signal gain adjustments are stored by controller **12** in memory **14** as signal gain adjustments Radj and Badj, respectively, e.g. Radj=135 and Badj=130. Of course, the preceding values are intended to illustrate and not limit the scope of the present invention.

Otherwise, ATW processing proceeds as illustrated in FIG. **2**. Utilizing the sample modified signal gain adjustment values mentioned above, the ATW control area of FIG. **4**(*a*) is correspondingly corrected by shifting the area by seven R gain units and two B gain units as shown in FIG. **6**.

In a further embodiment of imaging device **100**, controller **12** stores multiple sets of R signal gain adjustment and B signal gain adjustment values produced by successive implementation of the above-described AWB operation and/or manual adjustment of the ATW control area. For example, Radj and Badj values from a previous ten AWB operations may be stored in memory **14** for selective recall by a user.

Preferably, sets of R signal gain adjustment and B signal gain adjustment values, Radj and Badj, are stored in memory **14** as (Rawb[1], Bawb[1]), (Rawb[2], Bawb[2]) . . . (Rawb[10], Bawb[10]) in reverse chronological order, where "(Rawb[x], Bawb[x])" (x=1, 2, . . . 10) represents a pair of registers, or simply address locations, in memory **14**. Preferably, after each AWB operation or manual adjustment of the ATW control area, the oldest R signal gain adjustment value and the oldest B signal gain adjustment value, e.g. the values stored in (Rawb[10], Bawb[10]), are discarded; each of the remaining pairs of values are shifted by one register (address location is incremented); and the new R and B signal gain adjustment values are stored in (Rawb[1], Bawb[1]). In this manner, the reverse chronological order is preserved.

A method of ATW processing with storage of multiple signal gain adjustment values is illustrated in FIG. **7**. In step **F201**, processing is executed as described above with respect to step **F101** but is followed by step **F202**. In step **F202**, processing is executed as described above with respect to step **F102** but is followed by step **F203**.

In step **F203**, an offset for the ATW control area is calculated as a function of the distribution of the pairs of Radj and Badj values stored in memory **14**, e.g. (Rawb[1], Bawb[1]), (Rawb[2], Bawb[2]) . . . (Rawb[10], Bawb[10]). This calculation will be described in further detail hereinbelow. Controller **12** corrects (shifts) the ATW control area by an amount equal to the calculated R gain offset and B gain offset values.

In subsequent step **F204**, if either R_{GAIN} or B_{GAIN} is outside the corrected ATW control area, i.e. represent values not included among the set of values represented by the ATW control area, then controller **12** determines that the present corresponding image is not suitable for use in white balance adjustment, amplifiers **5R** and **5B** are not adjusted, and processing returns to step **F201**. If both R_{GAIN} and B_{GAIN} are within the corrected ATW control area, i.e. represent values included among the set of values represented by the ATW control area, then controller **12** determines that the present corresponding image is suitable for use in white balance adjustment and processing proceeds with step **F205**.

In step **F205**, processing is executed as described above with respect to step **F105** but is followed by step **F201**.

The offset calculation of step **F203** will be described in further detail in connection with the flow chart of FIG. **8** and the diagram of FIG. **10**(*b*). FIG. **10**(*b*) illustrates a portion of the ATW control area shown in FIG. **4**(*a*) and shows, specifically, nine pairs of Radj and Badj values represented as points S1, S2, S3, S5, S6 . . . S10. For the purposes of explanation, and not as a limitation on the present invention, it is assumed that memory **14** has stored ten pairs of Radj and Badj values corresponding to points S1, S2, . . . S10 as follows:

S1: (127,127) is stored at (Rawb[1], Bawb[1])

S2: (129,126) is stored at (Rawb[2], Bawb[2])

S3: (144,108) is stored at (Rawb[3], Bawb[3])

S4: (241,200) is stored at (Rawb[4], Bawb[4])

S5: (120,130) is stored at (Rawb[5], Bawb[5])

S6: (123,134) is stored at (Rawb[6], Bawb[6])

S7: (142,119) is stored at (Rawb[7], Bawb[7])

S8: (108,118) is stored at (Rawb[8], Bawb[8])

S9: (121,146) is stored at (Rawb[9], Bawb[9])

S10: (127,129) is stored at (Rawb[10], Bawb[10])

Of course, another positive number of pairs of Radj and Badj values other than ten could be utilized equally effectively.

It is preferable to define a sample area SA within the ATW control area as corresponding to a particular type of lighting. For example, FIG. **10**(*b*) illustrates a sample area SA which may correspond to light having an approximate temperature of 3200K, e.g. Radj and Badj have values greater than 120 but less than 136. Alternatively, sample area SA may have another shape such as a circle, an ellipse, or the like.

As shown, points S1, S2, S5, S6, and S10 lie within sample area SA, while points S3, S4, S7, S8, and S9 lie outside sample area SA. The points inside sample area SA may be considered similar to the desired type of lighting, and therefore, useful in adjusting the ATW control area. The points outside sample area SA may be considered too different from the desired type of lighting to be useful in adjusting the ATW control area. By separately averaging the Radj and Badj values represented by the points inside sample area SA, an average R gain adjustment value (Rav) and an average B gain adjustment value (Bav) can be calculated. These average values can then be used as offsets to correct (shift) the ATW control area.

FIG. **8** illustrates steps **F231–F239** which form step **F203** by which controller **12** determines which stored points fall within the desired range and separately averages the values corresponding to such points. In step **F231**, a variable n is initialized by controller **12** with the value 1. Next, in step **F232** a variable m is initialized by controller **12** with the value 1. Processing proceeds with step **F233**.

In step **F233**, controller **12** determines whether point Sn, i.e. (Rawb[n], Bawb[n]), is located within the desired sample area SA. If Sn is within SA, processing proceeds with step **F234**; otherwise, processing proceeds with step **F236**.

In step **F234**, the value stored at Rawb[n] is temporarily stored at another address, or register, Rsp[m], as a desired sampled R gain adjustment value. Similarly, the value stored at Bawb[n] is temporarily stored at another address, or register, Bsp[m], as a desired sampled B gain adjustment value. In the next step **F235**, the variable m is incremented by 1 and processing proceeds with step **F236**.

In step **F236**, if the variable n is less than the number of points to be considered, e.g. 10, then variable n is incremented by 1 and processing proceeds with step **F233**. Otherwise, processing proceeds with step **F240** in which m is decremented by 1. Utilizing the data and sample area SA provided in FIG. **10**(*b*) as an example, the desired sampled R and B gain adjustment values determined by controller **12** would be stored in memory **14** as follows:

Rsp[1]=127, Bsp[1]=127 (corresponding to point S1)

Rsp[2]=129, Bsp[2]=126 (corresponding to point S2)

Rsp[3]=120, Bsp[3]=130 (corresponding to point S5)

Rsp[4]=123, Bsp[4]=134 (corresponding to point S6)

Rsp[5]=127, Bsp[5]=129 (corresponding to point S10)

Following step **F240**, in step **F238**, controller **21** calculates an average R gain adjustment value (Rav) as the average of the m desired sampled R gain adjustment values. For example, the desired sampled R gain adjustment values are summed and the sum is divided by the number m to produce Rav. Similarly, controller **21** calculates an average B gain adjustment value (Bav) as the average of the m desired sampled B gain adjustment values. For example, the desired sampled B gain adjustment values are summed and the sum is divided by the number m to produce Bav. Utilizing the desired sample gain adjustment values provided in the example above,

Rav=(127+129+120+123+127)/5=125 and

Bav=(127+126+130+134+129)/5=129.

Processing proceeds with step **F239**.

In step **F239**, an offset for the ATW control area is calculated by subtracting the ideal intermediate amplification value, e.g. 128 in the present example, from each of the average gain adjustment values Rav and Bav. Continuing the example above, an R gain offset of −3 (=125−128) and a B gain offset of 1 (=129−128) can be calculated. Controller **12** corrects (shifts) the ATW control area by an amount equal to the calculated R gain offset and B gain offset values. Further to the above example, correction of the ATW control area of FIG. **4**(*a*) is achieved by shifting the ATW control area by three R gain units (to the left) and one B gain unit as shown in FIG. **10**(*a*).

By sampling past gain adjustment values, controller **12** estimates the most acceptable correction amount (shifting) for the ATW control area to enable proper white balance operation under what is expected to be similar future lighting conditions. Controller **12** thus "learns" how much to adjust the ATW control area based upon past experience with previous AWB operations and/or manual ATW control area adjustments. Consequently, the white balance operation is optimized for a particular image based upon past white balance results and an improved white balance operation is achieved.

It is further noted that statistically, in imaging a certain image, periodic AWB operations will produce pairs of R and B signal gain adjustment values which have a distribution similar to that of a black body radiation curve. Thus, the historical values of the pairs of R and B signal gain adjustment values are an advantageous basis for an ATW control area. Upon repeated ATW operations, the ATW control area will be adjusted to center on the distribution of past pairs of R and B signal gain adjustment values.

In an alternate embodiment, step **F240** is modified such that controller **21**, after having decremented the variable m by one, determines if m is greater than a minimum value mv. For example, mv may equal five. If m is greater than mv, processing is proceeds with step **F238**; otherwise, no adjustment of the ATW control area is made at that time and processing proceeds with step **F201**. Such a feature limits the frequency of ATW control area adjustment until a minimum number of images having a relatively consistent pattern of lighting are imaged. Overall ATW control area adjustment and thus, white balance operation, are thereby improved.

As an alternative to the above-described processing of step **F203**, controller **12** may instead determine from the R signal gain adjustment and B signal gain adjustment values, Radj and Badj, stored in memory **14** as (Rawb[1], Bawb[1]), (Rawb[2], Bawb[2]) . . . (Rawb[x], Bawb[x]), the R gain offset and B gain offset values which will result in the corrected ATW control area encompassing the most pairs of stored R and B signal gain adjustment values. For example, FIG. **11**(*a*) illustrates ten points representing pairs of stored R and B signal gain adjustment values and an ATW control

area. A maximization of the number of points encompassed by the ATW control area is illustrated in FIG. 11(b). This maximization may be achieved by a number of different conventional methods, such as a line-fit, a curve fit to black body radiation curve BBR, an area-fit to a sample number of points, or the like.

As will be understood by one of ordinary skill in the art, the term amplify, and synonyms thereof, utilized in the present specification refer to and encompass both the process of amplification and de-amplification. Also, color signals other than the red color signal and the blue color signal described herein, such as a green color signal, a yellow color signal, or the like, may be adjusted by the invention of the present application without departing from its scope.

Although illustrative embodiments of the present invention and modifications thereof have been described in detail herein, it is to be understood that this invention is not limited to these precise embodiments and modifications, and that other modifications and variations may be effected therein by one skilled in the art without departing from the scope and spirit of the invention as defined by the appended claims.

What is claimed is:

1. An imaging apparatus comprising:

imaging means for converting an image into a plurality of color signals each having a signal level;

white balance amplifier means, including at least first and second amplifiers for amplifying respective color signals, coupled to said imaging means, for adjusting the signal level of said plurality of color signals to produce a plurality of amplified color signals;

calibration means for calibrating said white balance amplifier means and for producing at least one calibration parameter defining an automatic tracing white balance (ATW) control area which substantially tracks a black body radiation pattern, and is shifted with respect to intermediate gain values of said first and second amplifiers in accordance with results of an automatic white balance (AWB) measurement;

detecting means, coupled to said white balance amplifier means, for detecting said plurality of amplified color signals;

calculation means, coupled to said detecting means, for calculating, in an ATW operation, at least one white balance amplification adjustment as a function of said plurality of amplified color signals;

comparing means for comparing said at least one white balance amplification adjustment with said at least one calibration parameter; and

automatic adjustment means for automatically adjusting said white balance amplifier means to amplify the signal level of at least one of said plurality of color signals if said at least one white balance amplification adjustment is within said shifted ATW control area, and not adjusting said white balance amplifier means if said at least one white balance amplification adjustment is outside said shifted ATW control area.

2. Apparatus according to claim 1, further comprising storage means for storing said at least one calibration parameter and wherein said comparing means retrieves said at least one calibration parameter from said storage means.

3. Apparatus according to claim 1, wherein said calibration means comprises means for automatic white balancing.

4. Apparatus according to claim 1, wherein said calibration means comprises at least one user-adjustable signal adjustment means for adjusting the signal level of at least one of said plurality of color signals.

5. Apparatus according to claim 1, wherein said at least one calibration parameter comprises a plurality of calibration parameters.

6. Apparatus according to claim 1, wherein said at least one calibration parameter comprises a red color gain adjustment value.

7. Apparatus according to claim 1, wherein said at least one calibration parameter comprises a blue color gain adjustment value.

8. Apparatus according to claim 1, wherein said at least one calibration parameter comprises a green color gain adjustment value.

9. An imaging apparatus comprising:

imaging means for converting an image into a plurality of color signals each having a signal level;

white balance amplifier means, coupled to said imaging means, for adjusting the signal level of at least one of said plurality of color signals to produce a plurality of amplified color signals;

calibration means for repeatedly calibrating said white balance amplifier means and for producing a plurality of calibration parameters;

detecting means, coupled to said white balance amplifier means, for detecting said plurality of amplified color signals;

first calculation means, coupled to said detecting means, for calculating at least one white balance amplification adjustment as a function of said plurality of amplified color signals;

storage means for storing said plurality of calibration parameters;

second calculation means for retrieving said plurality of calibration parameters from said storage means and for calculating an overall calibration factor as a function of said plurality of calibration parameters;

comparing means for comparing said at least one white balance amplification adjustment with said overall calibration factor; and

automatic adjustment means for automatically adjusting said white balance amplifier means to amplify the signal level of at least one of said plurality of color signals if said at least one white balance amplification adjustment is consistent with said overall calibration factor.

10. Apparatus as in claim 9, wherein said second calculation means calculates said overall calibration factor as an average of said plurality of calibration parameters.

11. Apparatus as in claim 9, wherein said second calculation means calculates said overall calibration factor as an average of calibration parameters corresponding to a color.

12. Apparatus as in claim 9, wherein said second calculation means calculates said overall calibration factor as a function of a distribution of said plurality of calibration parameters.

13. Apparatus as in claim 9, wherein said second calculation means calculates said overall calibration factor as a function of a plurality of calibration factors which are representative of a lighting condition.

14. Apparatus according to claim 9, wherein said calibration means comprises means for automatic white balancing.

15. Apparatus according to claim 9, wherein said calibration means comprises at least one user-adjustable signal adjustment means for adjusting the signal level of at least one of said plurality of color signals.

16. Apparatus according to claim 9, wherein said plurality of calibration parameters comprises a red color gain adjustment value and a blue color gain adjustment value.

17. Apparatus according to claim 9, wherein said plurality of calibration parameters are characteristic of a black body radiation pattern.

18. Apparatus according to claim 9, wherein said plurality of calibration parameters define an ATW control area which is substantially symmetric about a black body radiation pattern.

19. Appparatus according to claim 18, wherein said automatic adjustment means automatically adjusts said white balance amplifier means to amplify the signal level of at least one of said plurality of color signals if said at least one white balance amplification adjustment is within said ATW control area.

20. Appparatus according to claim 19, wherein said automatic adjustment means automatically does not adjust said white balance amplifier means if said at least one white balance amplification adjustment is outside said ATW control area.

21. Apparatus according to claim 18, further comprising maximizing means for maximizing a number of points encompassed by said ATW control area.

22. Apparatus according to claim 21, wherein said maximizing means employs line-fitting.

23. Apparatus according to claim 21 wherein said maximizing means employs curve fitting to a black body radiation curve.

24. Apparatus according to claim 21 wherein said maximizing means employs an area-fit to a sample number of points.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : **5,995,142**

DATED : **Nov. 30, 1999**

INVENTOR(s) : **Matsufune**

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page, item [30],

IN THE FOREIGN APPLICATION PRIORITY DATA:

Apr. 2, 1996	[JP]	Japan......................8-102041
Feb. 3, 1997	[JP]	Japan......................9-032571

Signed and Sealed this

Twenty-fourth Day of October, 2000

Attest:

Q. TODD DICKINSON

Attesting Officer *Director of Patents and Trademarks*

US006493027B2

(12) United States Patent
Ohta et al.

(10) **Patent No.: US 6,493,027 B2**
(45) **Date of Patent: *Dec. 10, 2002**

(54) **APPARATUS FOR STILL AND MOVING IMAGE RECORDING AND CONTROL THEREOF**

(75) Inventors: **Seiya Ohta**, Kanagawa-ken (JP); **Kitahiro Kaneda**, Kanagawa-ken (JP); **Hirofumi Takei**, Kanagawa-ken (JP); **Taeko Tanaka**, Kanagawa-ken (JP)

(73) Assignee: **Canon Kabushiki Kaisha**, Tokyo (JP)

(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **08/916,621**

(22) Filed: **Aug. 22, 1997**

(65) **Prior Publication Data**

US 2001/0040626 A1 Nov. 15, 2001

Related U.S. Application Data

(62) Division of application No. 08/351,740, filed on Dec. 8, 1994, now Pat. No. 5,703,638, which is a continuation of application No. 07/948,001, filed on Sep. 21, 1992, now abandoned.

(30) **Foreign Application Priority Data**

Sep. 25, 1991	(JP)	3-245692
Oct. 21, 1991	(JP)	3-272627
Nov. 8, 1991	(JP)	3-293238
Jan. 21, 1992	(JP)	4-008654
Jan. 28, 1992	(JP)	4-012936

(51) **Int. Cl.**^{7} **H04N 5/225**

(52) **U.S. Cl.** **348/220**; 348/223

(58) **Field of Search** 348/208, 220, 348/221, 223, 224, 229, 347, 358, 362, 345, 349, 222; 386/8

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,780,766 A	* 10/1988	Nutting	348/229
4,899,212 A	* 2/1990	Kaneko et al.	348/220
5,276,563 A	* 1/1994	Ogawa	348/220
5,339,163 A	* 8/1994	Homma et al.	348/229
5,341,190 A	* 8/1994	Ogawa	348/221

* cited by examiner

Primary Examiner—Tuan Ho
(74) *Attorney, Agent, or Firm*—Robin, Blecker & Daley

(57) **ABSTRACT**

An image pickup apparatus capable of performing shooting action control appositely to each of different modes of shooting such as moving image shooting and still image shooting includes an instructing part for selectively instructing the apparatus to perform moving image shooting or still image shooting, and a control part for variably setting control characteristics for various control actions such as backlight correction control, white balance control, automatic focusing control, shutter speed control, etc., according to the instruction of the instructing part.

5 Claims, 26 Drawing Sheets

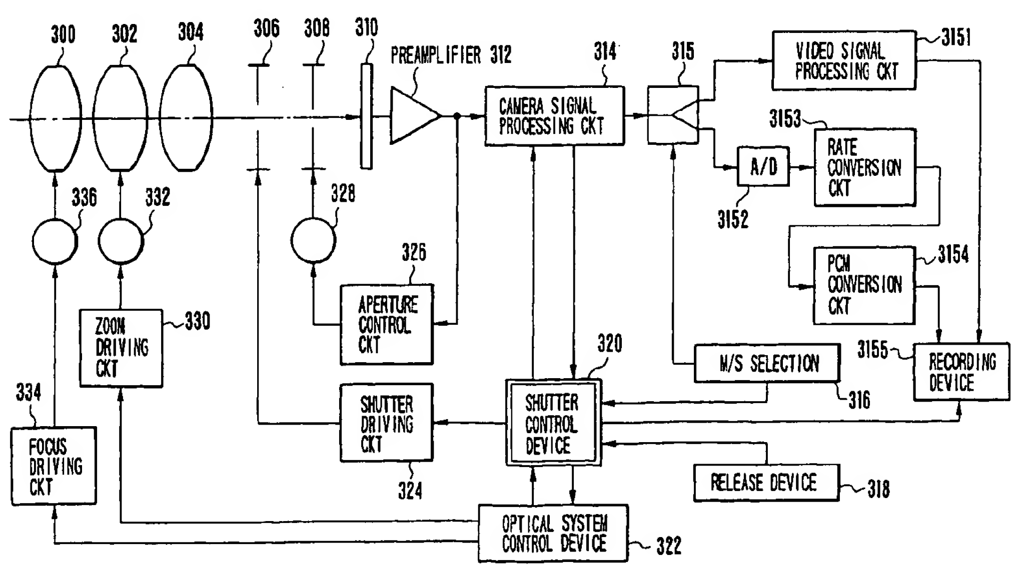


FIG. 1 (PRIOR ART)

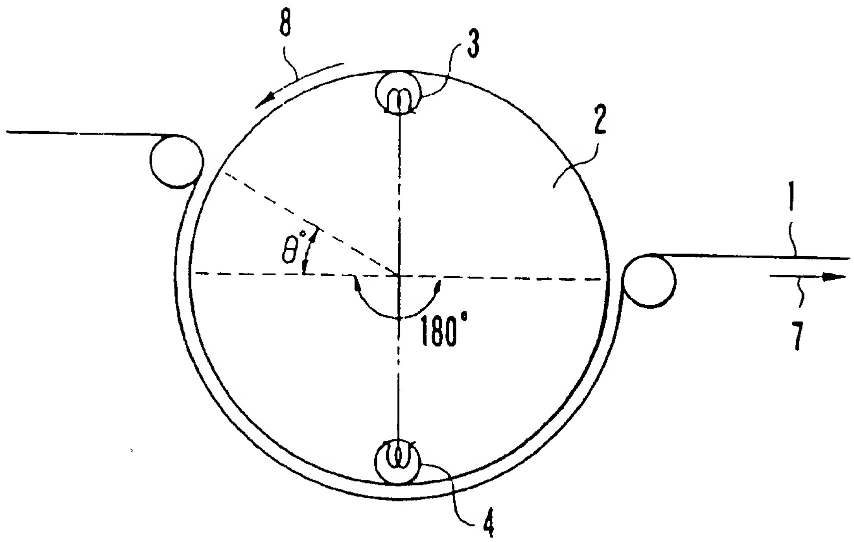


FIG. 2 (PRIOR ART)

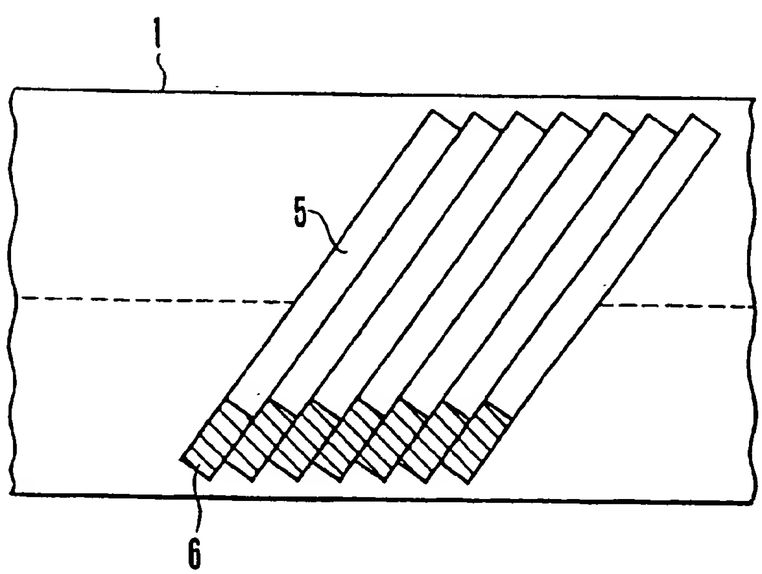


FIG.3

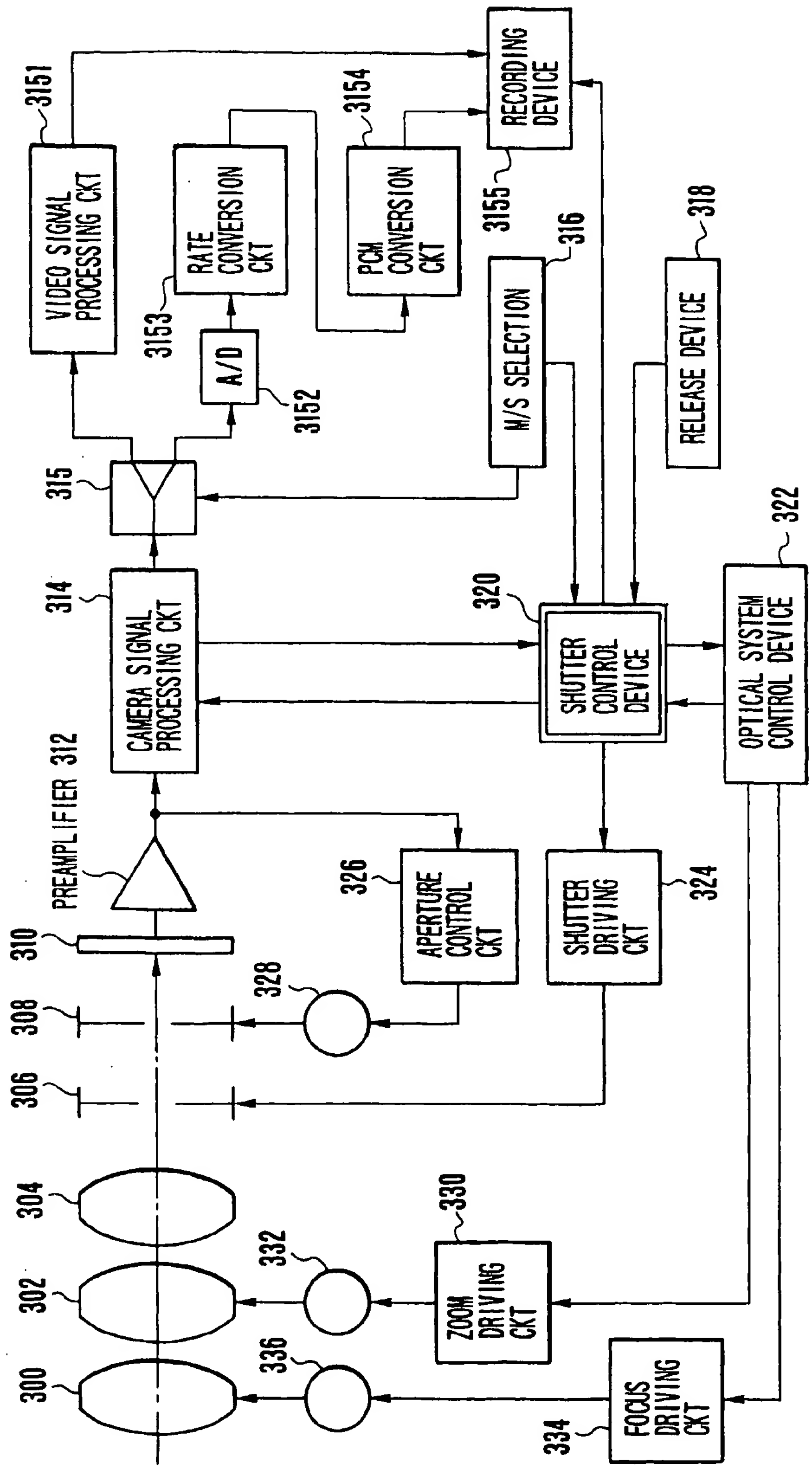
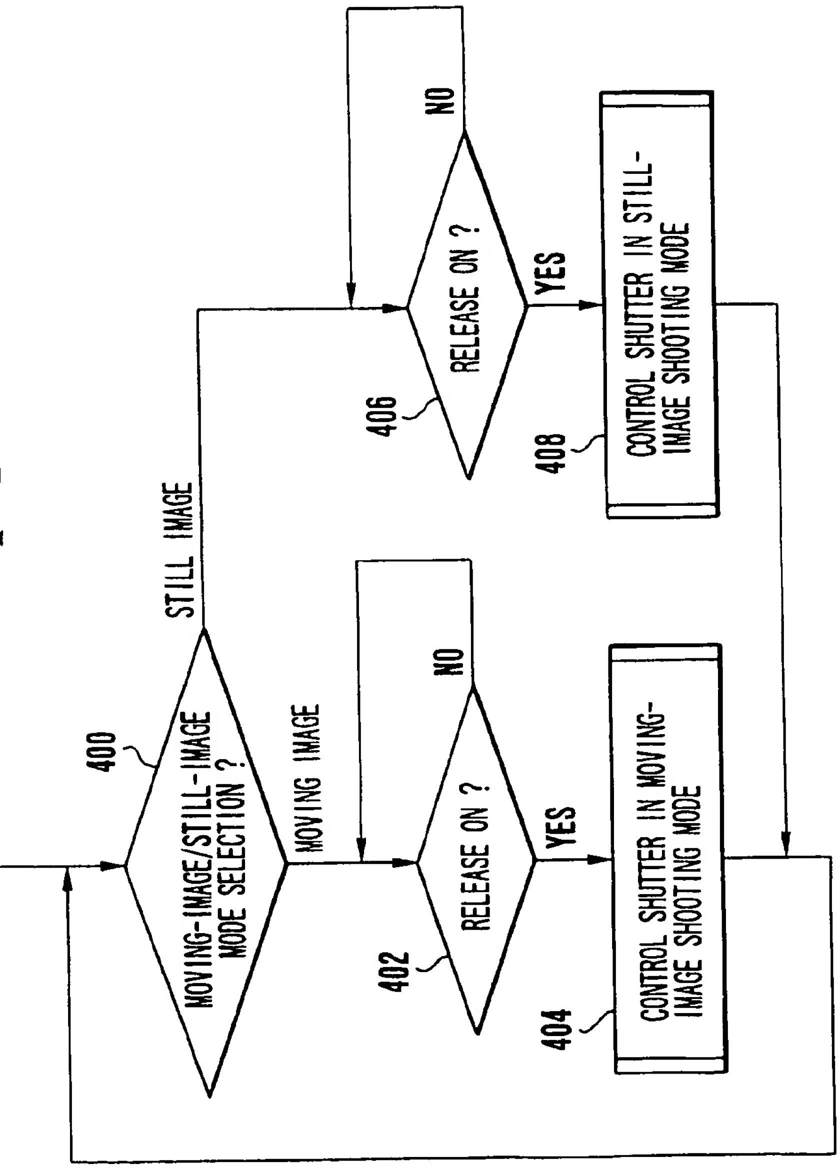

300
302
304
306
308
310
PREAMPLIFIER 312
314
CAMERA SIGNAL PROCESSING CKT
315
VIDEO SIGNAL PROCESSING CKT
3151
A/D
3152
RATE CONVERSION CKT
3153
PCM CONVERSION CKT
3154
RECORDING DEVICE
3155
M/S SELECTION
316
RELEASE DEVICE
318
SHUTTER CONTROL DEVICE
320
OPTICAL SYSTEM CONTROL DEVICE
322
SHUTTER DRIVING CKT
324
APERTURE CONTROL CKT
326
328
ZOOM DRIVING CKT
330
332
FOCUS DRIVING CKT
334
336

FIG. 4


400
MOVING-IMAGE/STILL-IMAGE MODE SELECTION ?
STILL IMAGE
MOVING IMAGE
402
RELEASE ON ?
NO
YES
404
CONTROL SHUTTER IN MOVING-IMAGE SHOOTING MODE
406
RELEASE ON ?
NO
YES
408
CONTROL SHUTTER IN STILL-IMAGE SHOOTING MODE

F I G.5

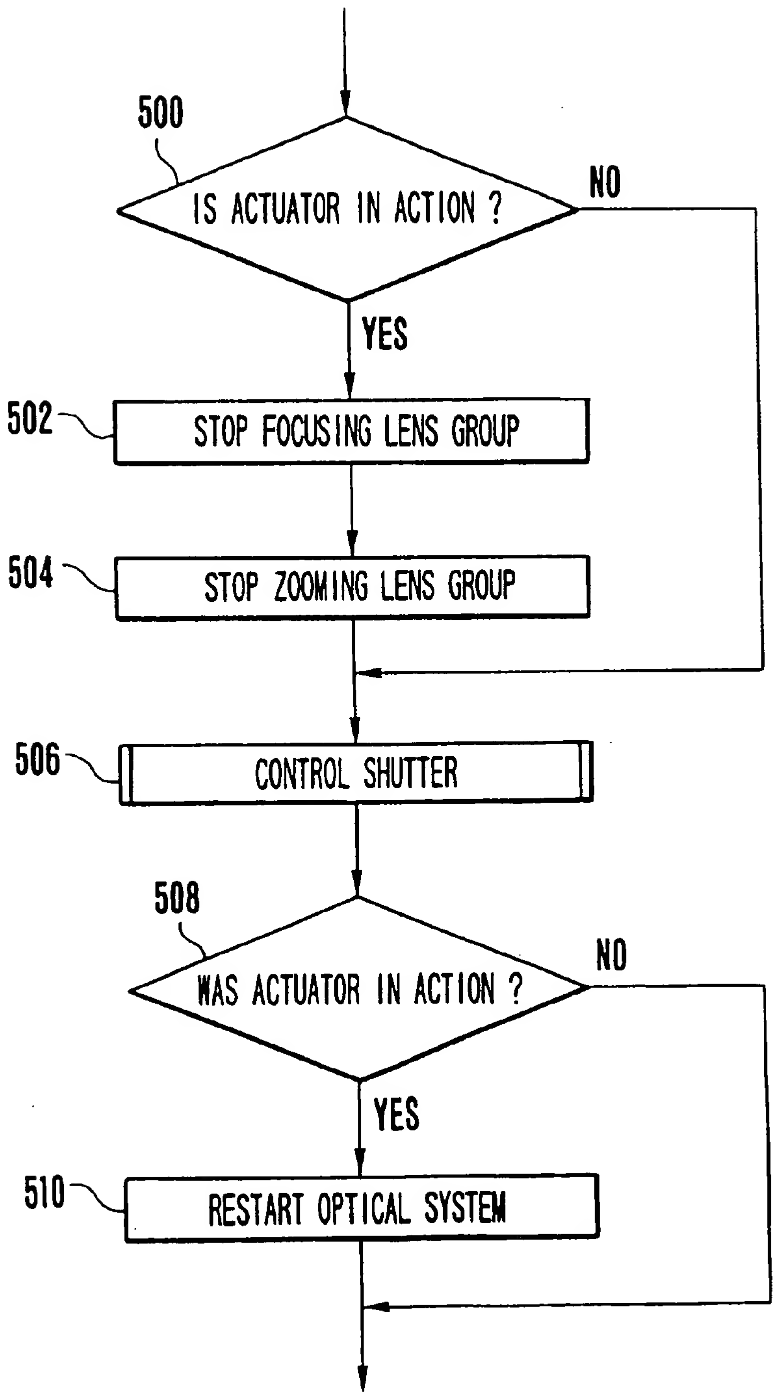

500
IS ACTUATOR IN ACTION ?
NO
YES
502
STOP FOCUSING LENS GROUP
504
STOP ZOOMING LENS GROUP
506
CONTROL SHUTTER
508
WAS ACTUATOR IN ACTION ?
NO
YES
510
RESTART OPTICAL SYSTEM

FIG.6

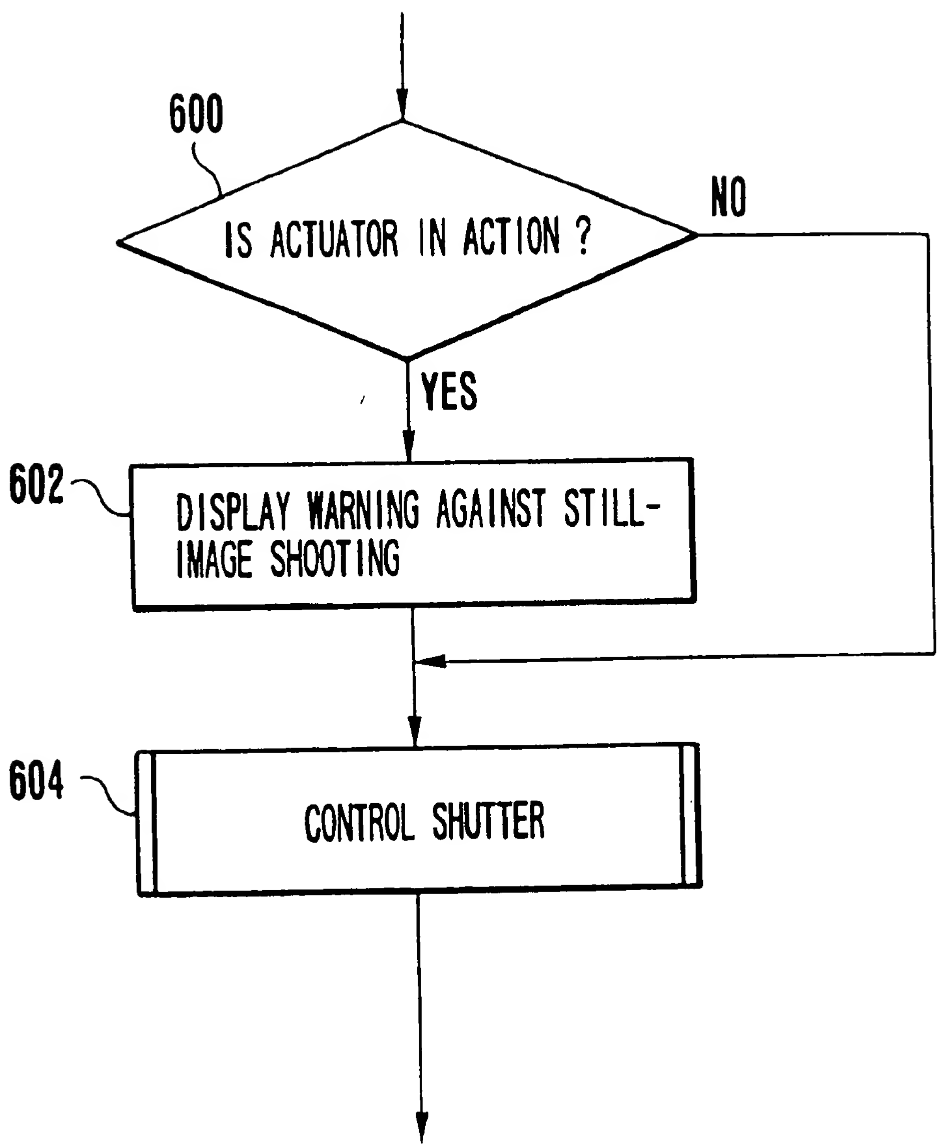

600
IS ACTUATOR IN ACTION ?
NO
YES
602
DISPLAY WARNING AGAINST STILL-IMAGE SHOOTING
604
CONTROL SHUTTER

FIG. 7

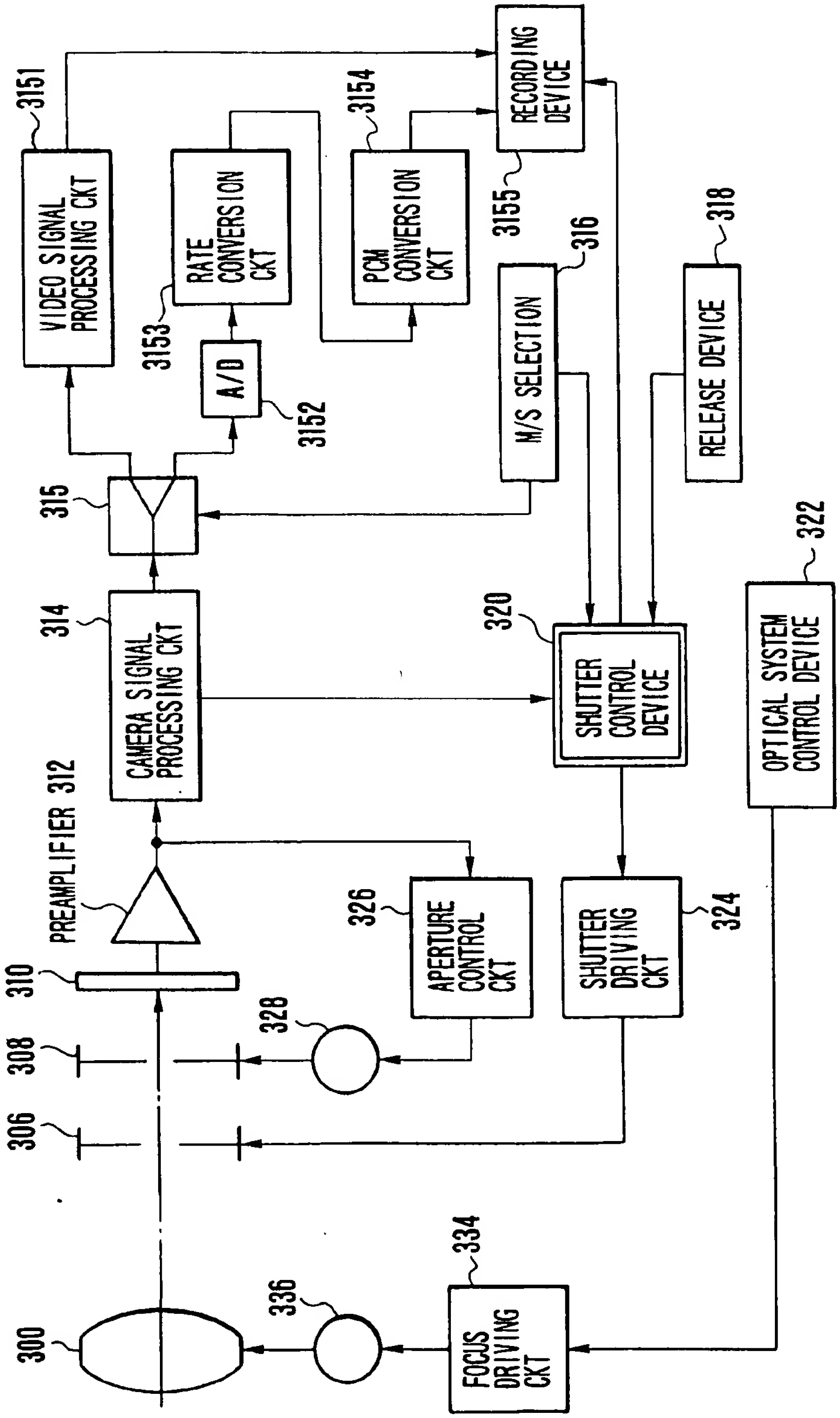

VIDEO SIGNAL PROCESSING CKT
3151
RATE CONVERSION CKT
3153
A/D
3152
PCM CONVERSION CKT
3154
RECORDING DEVICE
3155
315
M/S SELECTION
316
RELEASE DEVICE
318
314
CAMERA SIGNAL PROCESSING CKT
PREAMPLIFIER 312
320
SHUTTER CONTROL DEVICE
OPTICAL SYSTEM CONTROL DEVICE
322
310
308
306
326
APERTURE CONTROL CKT
SHUTTER DRIVING CKT
324
328
300
336
334
FOCUS DRIVING CKT

FIG.8

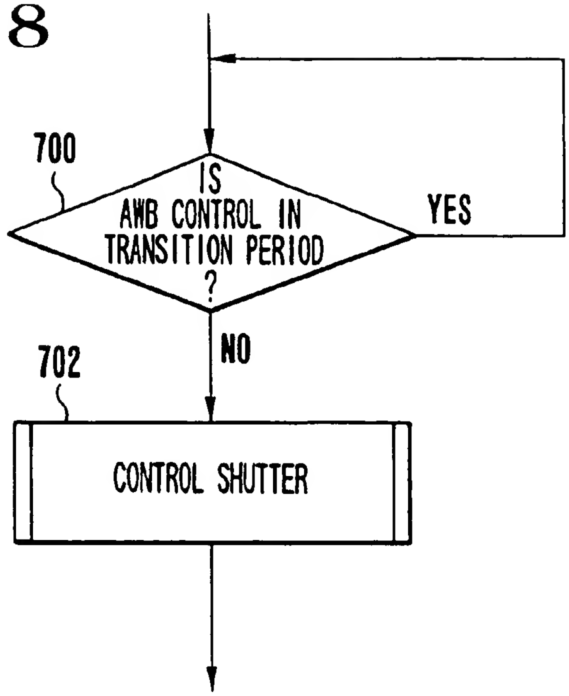

700
IS
AWB CONTROL IN
TRANSITION PERIOD
?
YES
NO
702
CONTROL SHUTTER

FIG.9

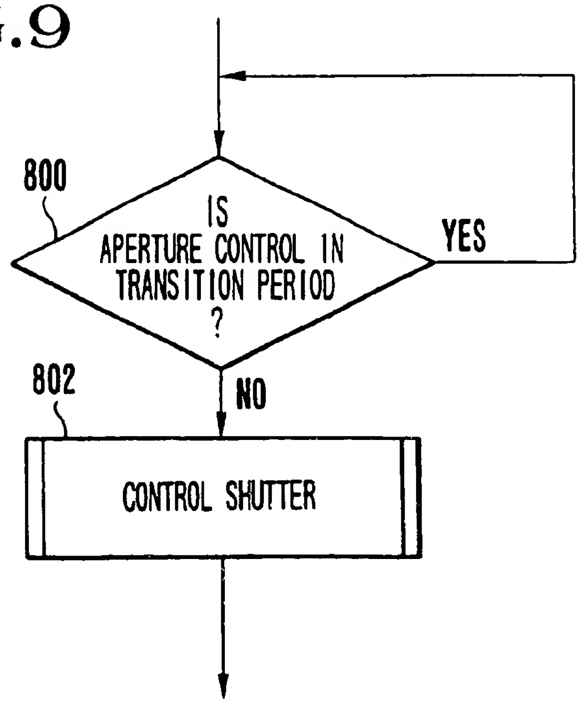
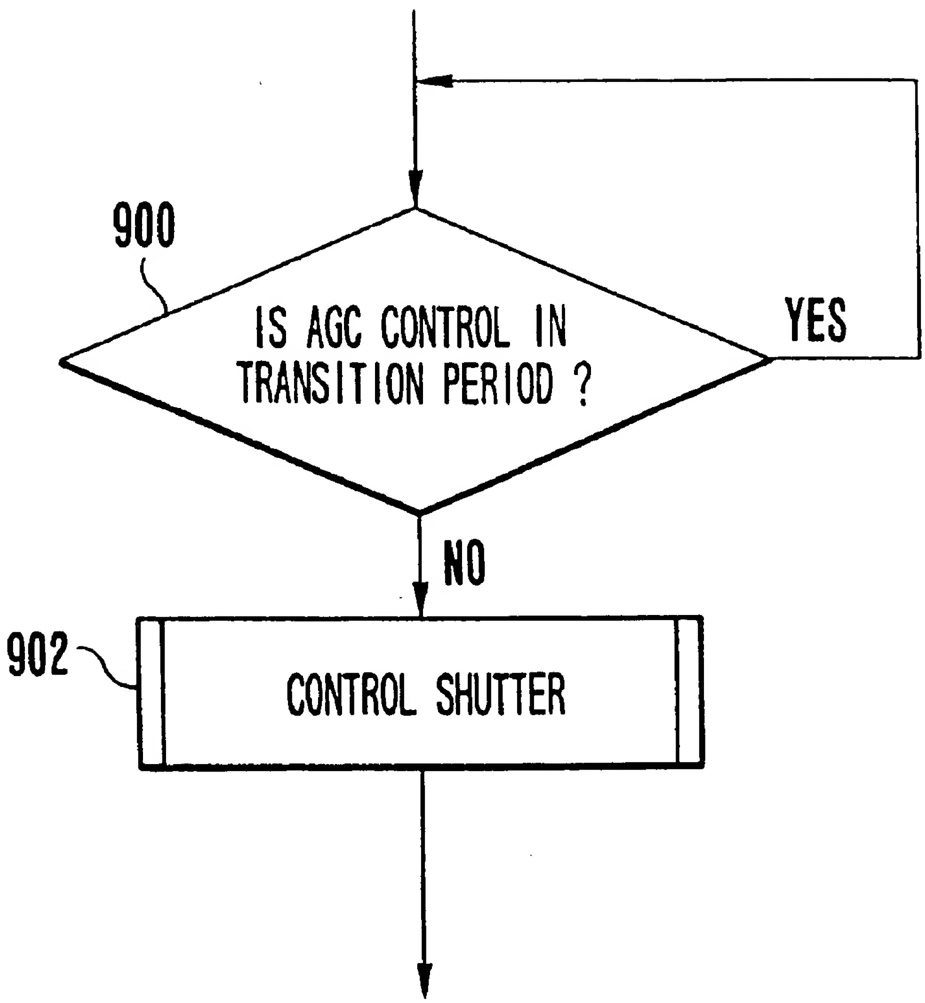
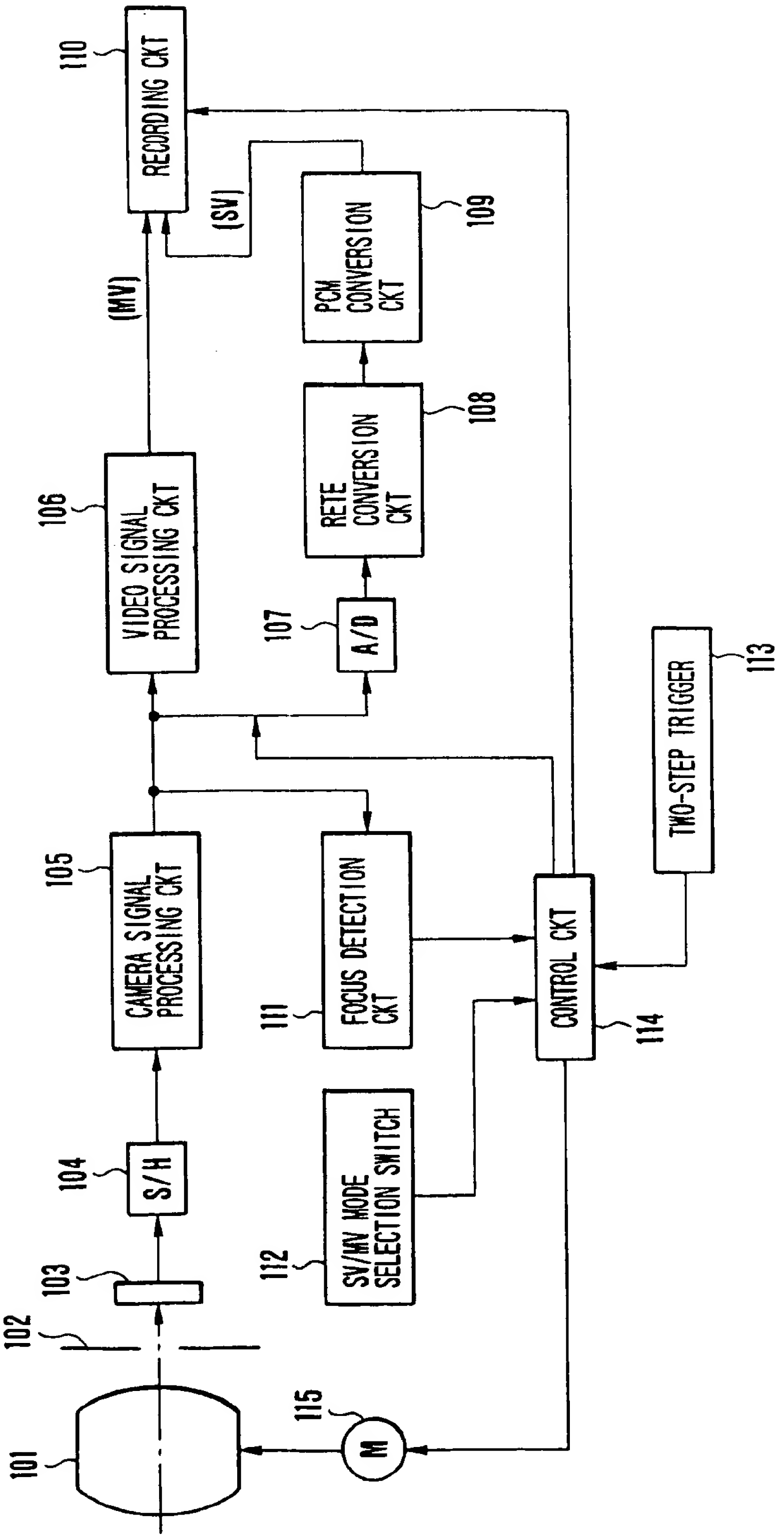

800
IS
APERTURE CONTROL IN
TRANSITION PERIOD
?
YES
NO
802
CONTROL SHUTTER

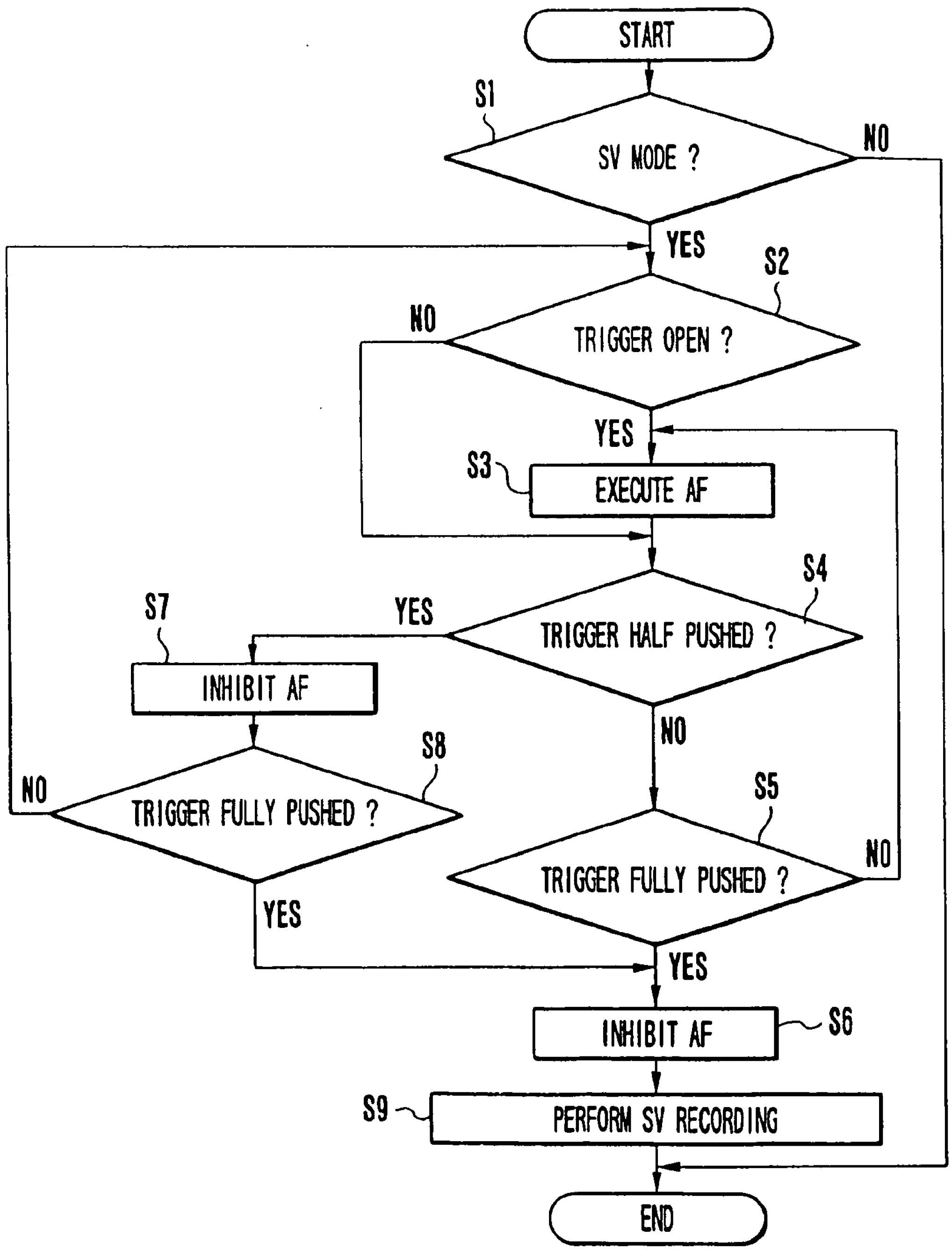
FIG.10


900
IS AGC CONTROL IN TRANSITION PERIOD ?
YES
NO
902
CONTROL SHUTTER

F I G.11


RECORDING CKT
110
(SV)
(MV)
PCM CONVERSION CKT
109
RETE CONVERSION CKT
108
VIDEO SIGNAL PROCESSING CKT
106
A/D
107
TWO-STEP TRIGGER
113
CAMERA SIGNAL PROCESSING CKT
105
FOCUS DETECTION CKT
111
CONTROL CKT
114
S/H
104
SV/MV MODE SELECTION SWITCH
112
103
102
101
M
115

F I G.12


START
S1
SV MODE ?
NO
YES
S2
NO
TRIGGER OPEN ?
YES
S3
EXECUTE AF
S4
S7
YES
TRIGGER HALF PUSHED ?
INHIBIT AF
NO
S8
NO
TRIGGER FULLY PUSHED ?
S5
NO
TRIGGER FULLY PUSHED ?
YES
YES
INHIBIT AF
S6
S9
PERFORM SV RECORDING
END

F I G.13

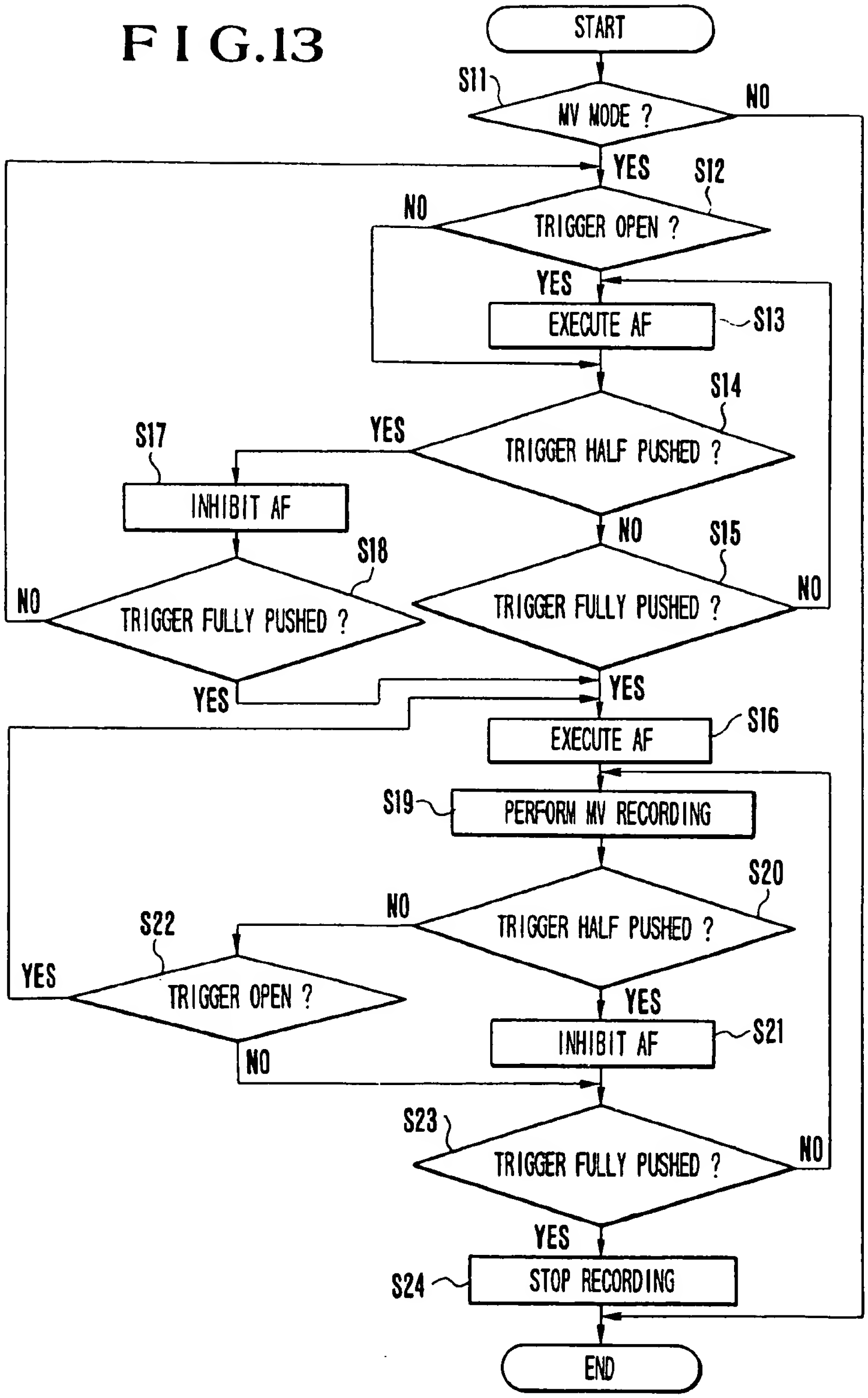
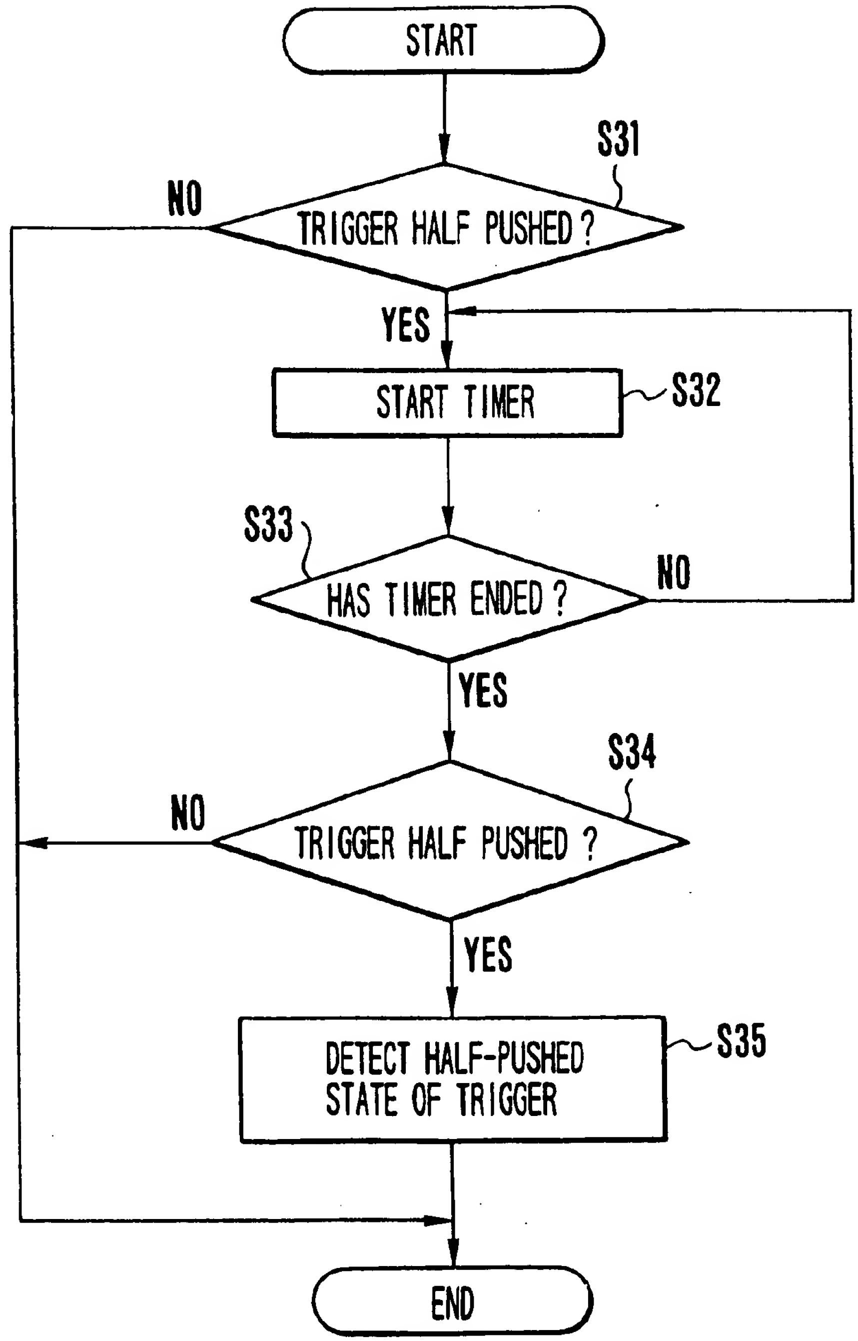
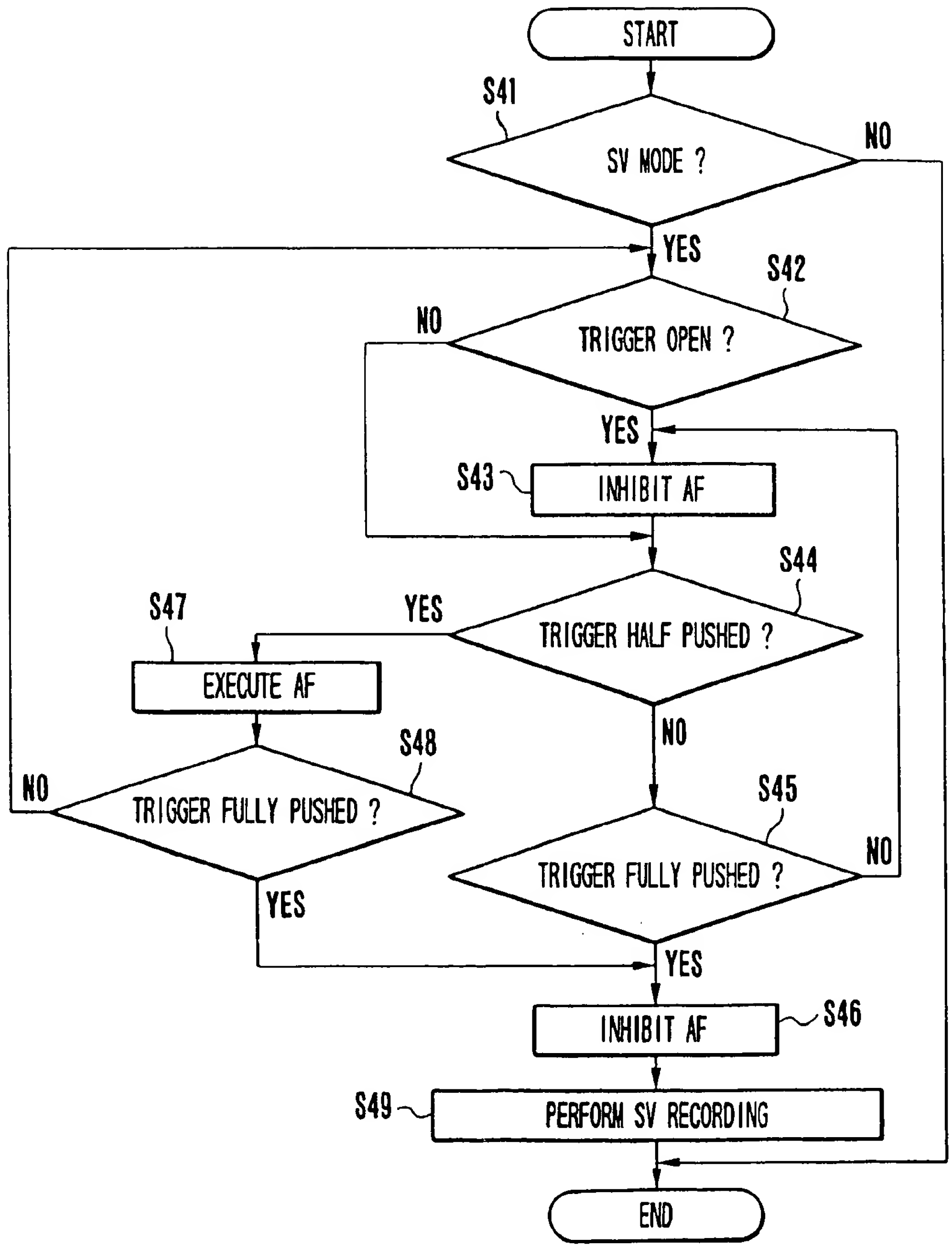

START
S11
MV MODE ?
NO
YES
S12
NO
TRIGGER OPEN ?
YES
EXECUTE AF
S13
S14
S17
YES
TRIGGER HALF PUSHED ?
INHIBIT AF
NO
S15
S18
NO
TRIGGER FULLY PUSHED ?
TRIGGER FULLY PUSHED ?
NO
YES
YES
EXECUTE AF
S16
S19
PERFORM MV RECORDING
S20
NO
S22
TRIGGER HALF PUSHED ?
YES
TRIGGER OPEN ?
YES
INHIBIT AF
S21
NO
S23
TRIGGER FULLY PUSHED ?
NO
YES
S24
STOP RECORDING
END

FIG.14


START
S31
NO
TRIGGER HALF PUSHED ?
YES
START TIMER
S32
S33
HAS TIMER ENDED ?
NO
YES
S34
NO
TRIGGER HALF PUSHED ?
YES
DETECT HALF-PUSHED STATE OF TRIGGER
S35
END

F I G.15


START
S41
SV MODE ?
NO
YES
S42
NO
TRIGGER OPEN ?
YES
S43
INHIBIT AF
S44
S47
YES
TRIGGER HALF PUSHED ?
EXECUTE AF
NO
S48
NO
TRIGGER FULLY PUSHED ?
S45
NO
TRIGGER FULLY PUSHED ?
YES
YES
INHIBIT AF
S46
S49
PERFORM SV RECORDING
END

F I G.16

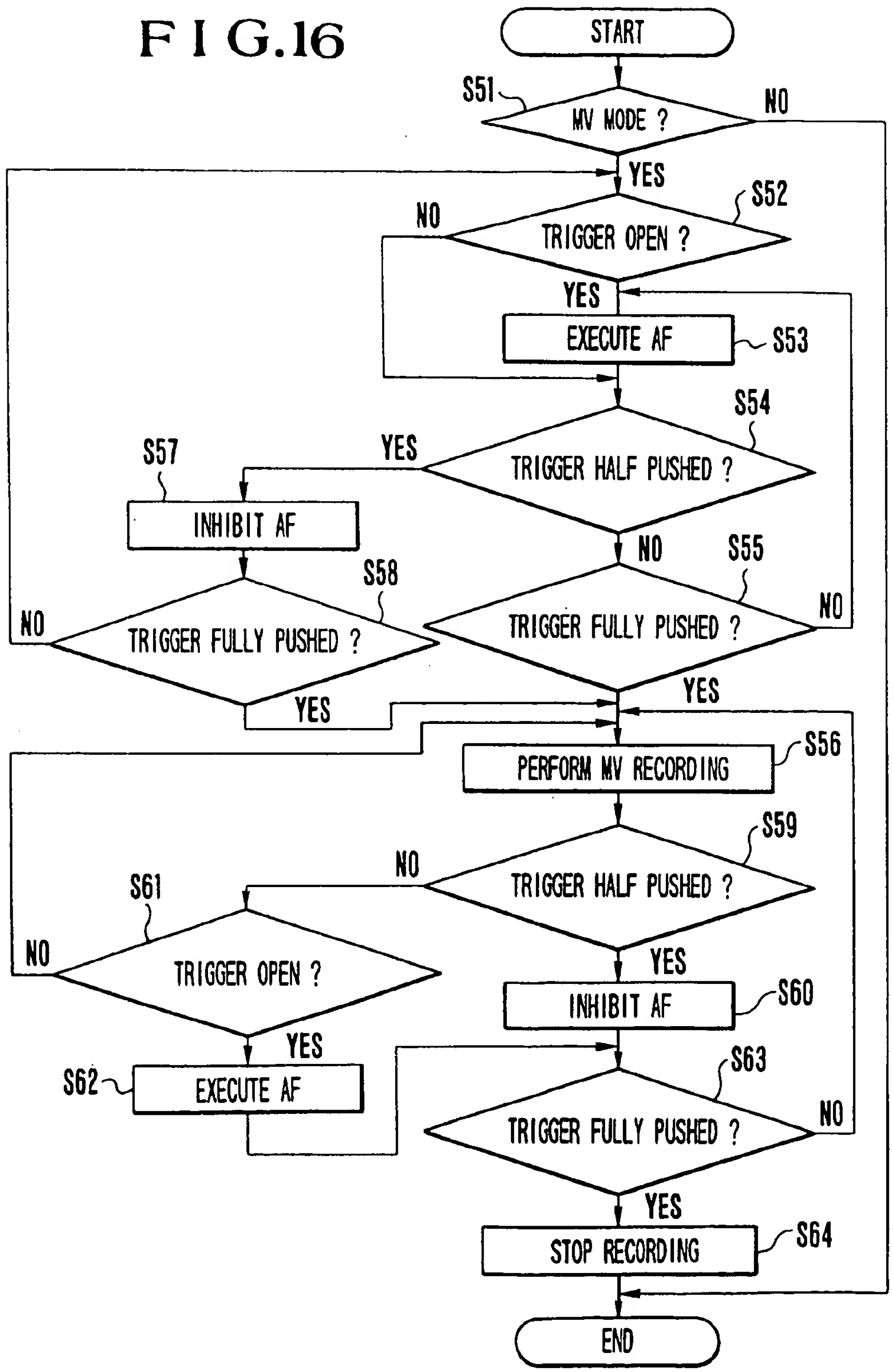

START
S51
MV MODE ?
NO
YES
S52
NO
TRIGGER OPEN ?
YES
EXECUTE AF
S53
S54
S57
YES
TRIGGER HALF PUSHED ?
INHIBIT AF
S58
NO
S55
NO
TRIGGER FULLY PUSHED ?
TRIGGER FULLY PUSHED ?
NO
YES
YES
S56
PERFORM MV RECORDING
S59
NO
S61
TRIGGER HALF PUSHED ?
NO
TRIGGER OPEN ?
YES
S60
INHIBIT AF
YES
S62
EXECUTE AF
S63
TRIGGER FULLY PUSHED ?
NO
YES
STOP RECORDING
S64
END

FIG.17

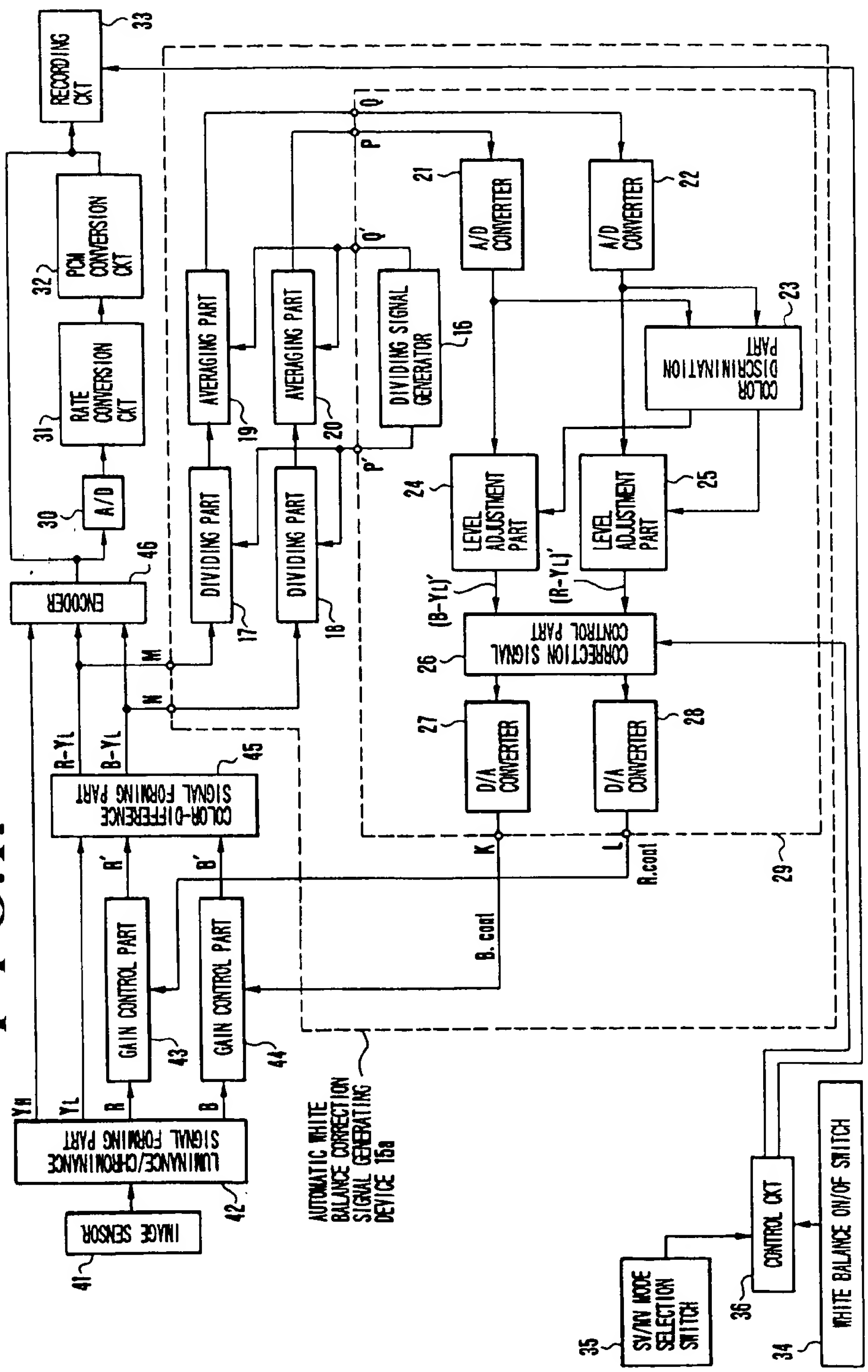

RECORDING CKT
PCM CONVERSION CKT
RATE CONVERSION CKT
A/D
ENCODER
AVERAGING PART
AVERAGING PART
DIVIDING SIGNAL GENERATOR
A/D CONVERTER
A/D CONVERTER
COLOR DISCRIMINATION PART
DIVIDING PART
DIVIDING PART
LEVEL ADJUSTMENT PART
LEVEL ADJUSTMENT PART
CORRECTION SIGNAL CONTROL PART
D/A CONVERTER
D/A CONVERTER
COLOR-DIFFERENCE SIGNAL FORMING PART
GAIN CONTROL PART
GAIN CONTROL PART
LUMINANCE/CHROMINANCE SIGNAL FORMING PART
IMAGE SENSOR
AUTOMATIC WHITE BALANCE CORRECTION SIGNAL GENERATING DEVICE 15a
SV/MV MODE SELECTION SWITCH
CONTROL CKT
WHITE BALANCE ON/OF SWITCH
R.cont
B.cont

FIG.18

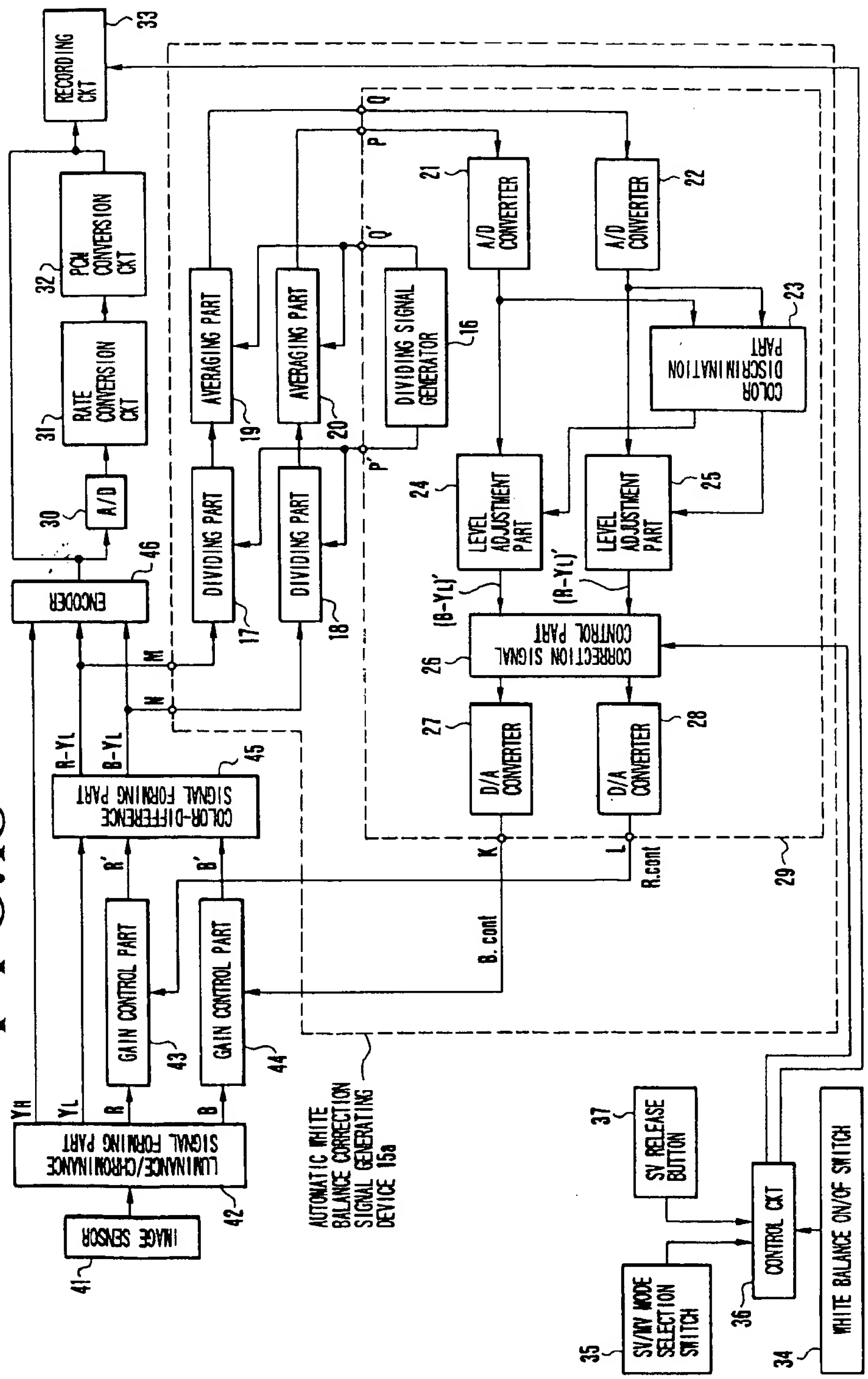

RECORDING CKT
33
PCM CONVERSION CKT
32
RATE CONVERSION CKT
31
A/D
30
ENCODER
46
AVERAGING PART
19
AVERAGING PART
20
DIVIDING SIGNAL GENERATOR
16
DIVIDING PART
17
DIVIDING PART
18
A/D CONVERTER
21
A/D CONVERTER
22
COLOR DISCRIMINATION PART
23
LEVEL ADJUSTMENT PART
24
LEVEL ADJUSTMENT PART
25
(B-YL)'
(R-YL)'
CORRECTION SIGNAL CONTROL PART
26
D/A CONVERTER
27
D/A CONVERTER
28
29
P
Q
P'
Q'
M
N
K
L
R.cont
B.cont
R-YL
B-YL
COLOR-DIFFERENCE SIGNAL FORMING PART
45
R'
B'
GAIN CONTROL PART
43
GAIN CONTROL PART
44
YH
YL
R
B
LUMINANCE/CHROMINANCE SIGNAL FORMING PART
42
IMAGE SENSOR
41
AUTOMATIC WHITE BALANCE CORRECTION SIGNAL GENERATING DEVICE 15a
SV RELEASE BUTTON
37
SV/MV MODE SELECTION SWITCH
35
CONTROL CKT
36
WHITE BALANCE ON/OF SWITCH
34

FIG.19

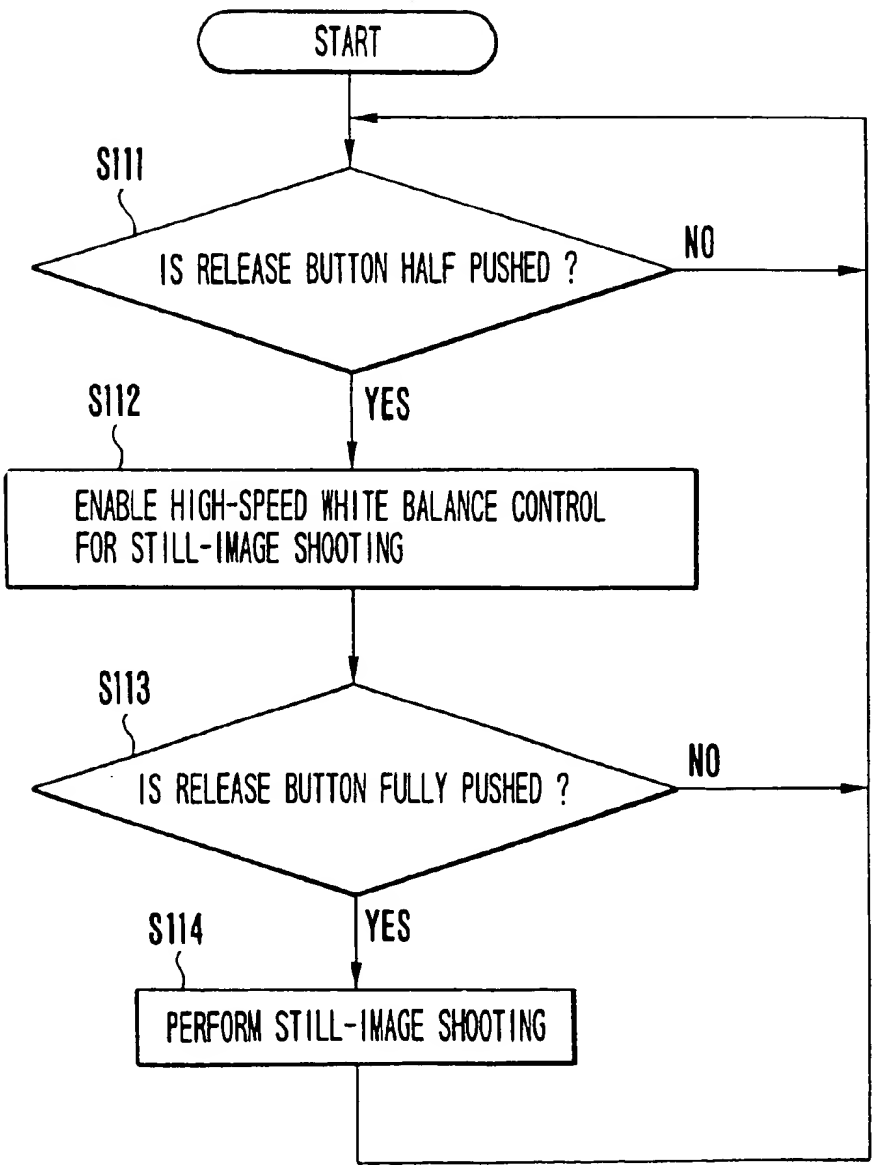

START
S111
IS RELEASE BUTTON HALF PUSHED ?
NO
YES
S112
ENABLE HIGH-SPEED WHITE BALANCE CONTROL FOR STILL-IMAGE SHOOTING
S113
IS RELEASE BUTTON FULLY PUSHED ?
NO
YES
S114
PERFORM STILL-IMAGE SHOOTING

FIG.20

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20

FIG.21

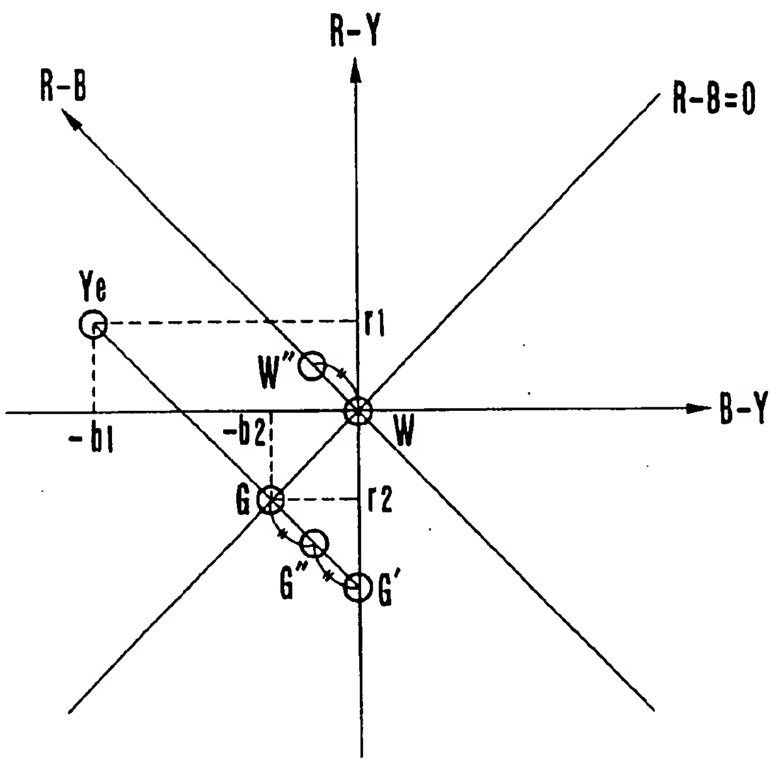


FIG. 22

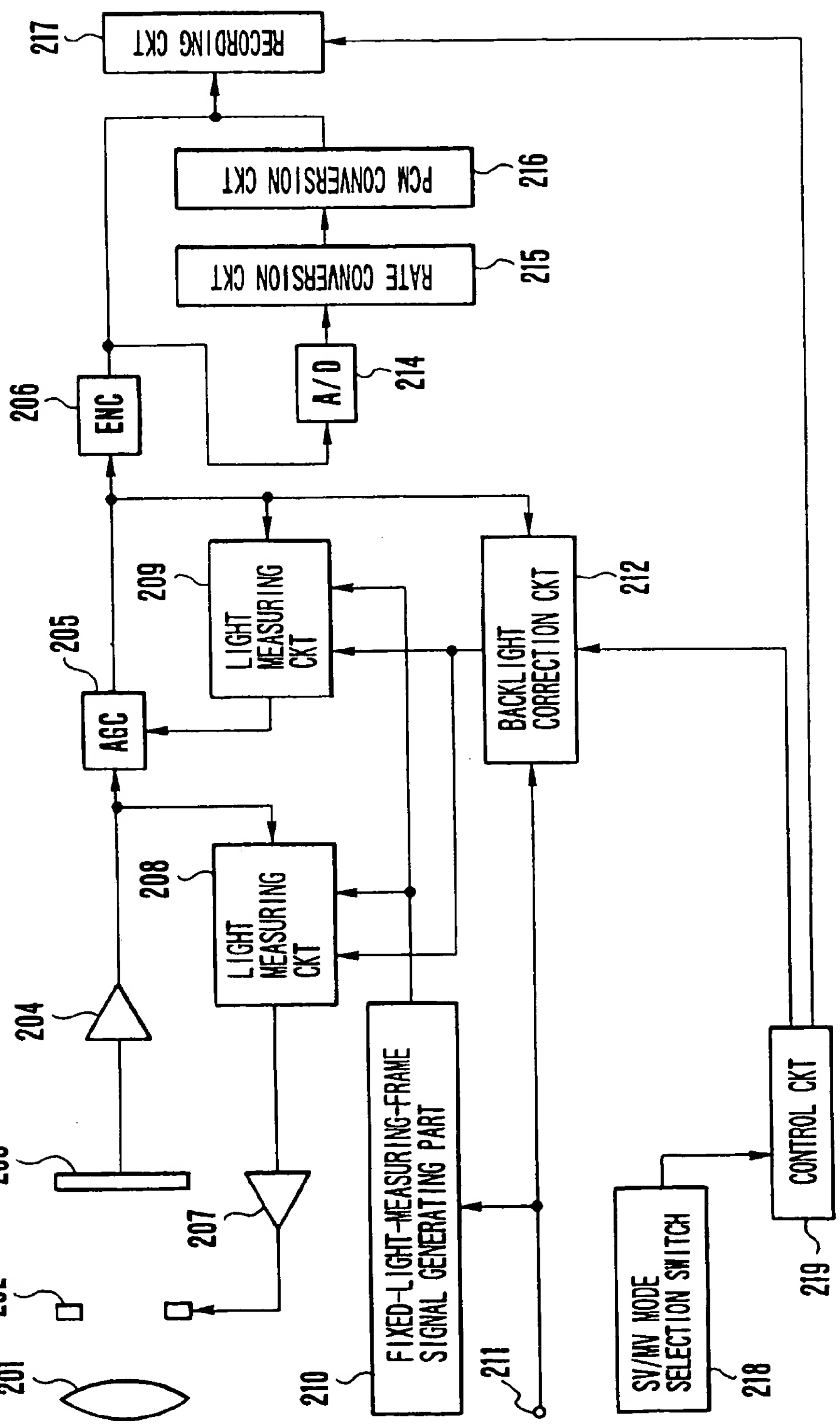

RECORDING CKT
PCM CONVERSION CKT
RATE CONVERSION CKT
A/D
ENC
AGC
LIGHT MEASURING CKT
LIGHT MEASURING CKT
BACKLIGHT CORRECTION CKT
FIXED-LIGHT-MEASURING-FRAME SIGNAL GENERATING PART
SV/MV MODE SELECTION SWITCH
CONTROL CKT
201
202
203
204
205
206
207
208
209
210
211
212
214
215
216
217
218
219

FIG.23

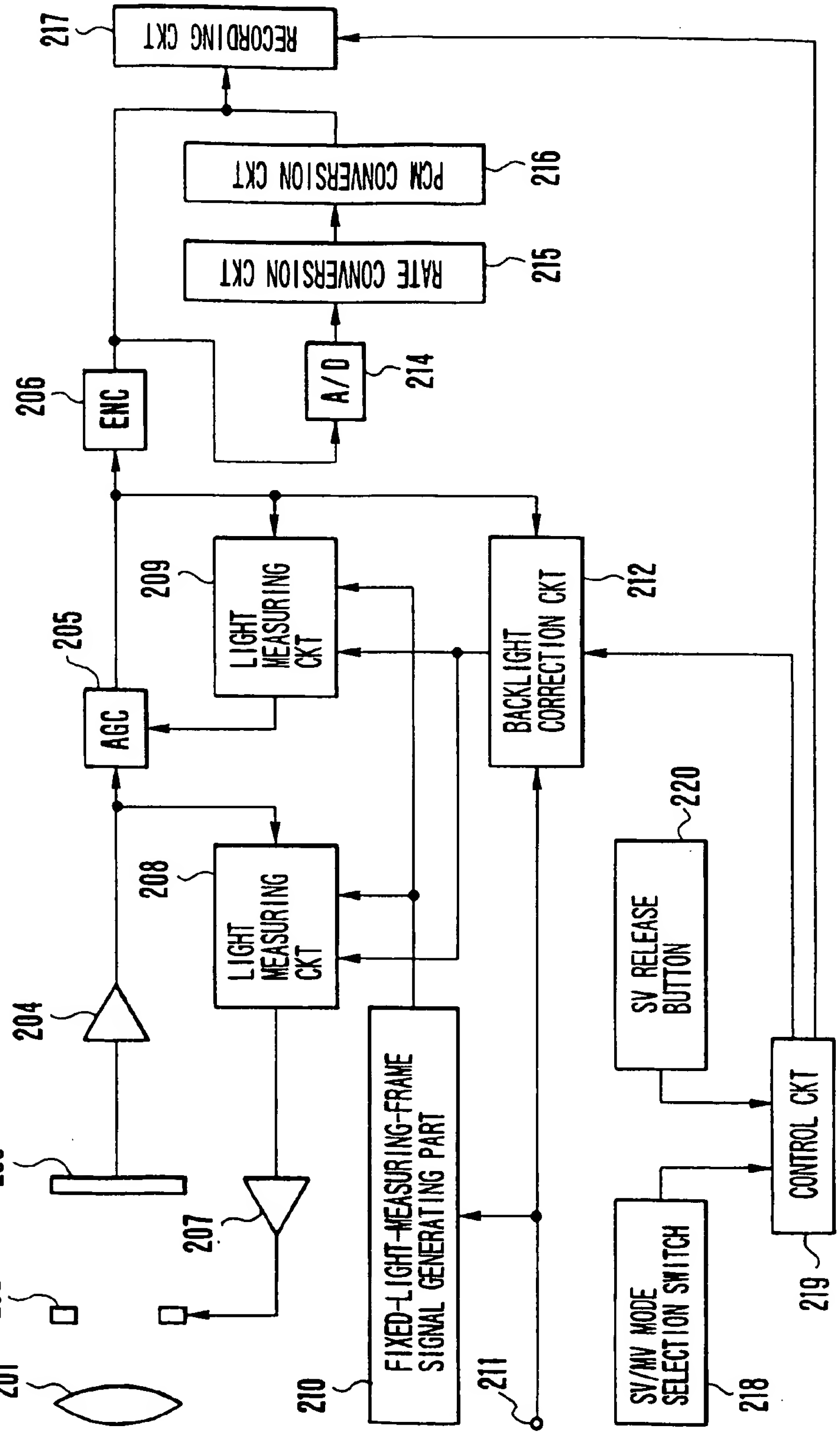

RECORDING CKT
PCM CONVERSION CKT
RATE CONVERSION CKT
A/D
ENC
AGC
LIGHT MEASURING CKT
LIGHT MEASURING CKT
BACKLIGHT CORRECTION CKT
SV RELEASE BUTTON
CONTROL CKT
SV/MV MODE SELECTION SWITCH
FIXED-LIGHT-MEASURING-FRAME SIGNAL GENERATING PART
201
202
203
204
205
206
207
208
209
210
211
212
214
215
216
217
218
219
220

FIG.24

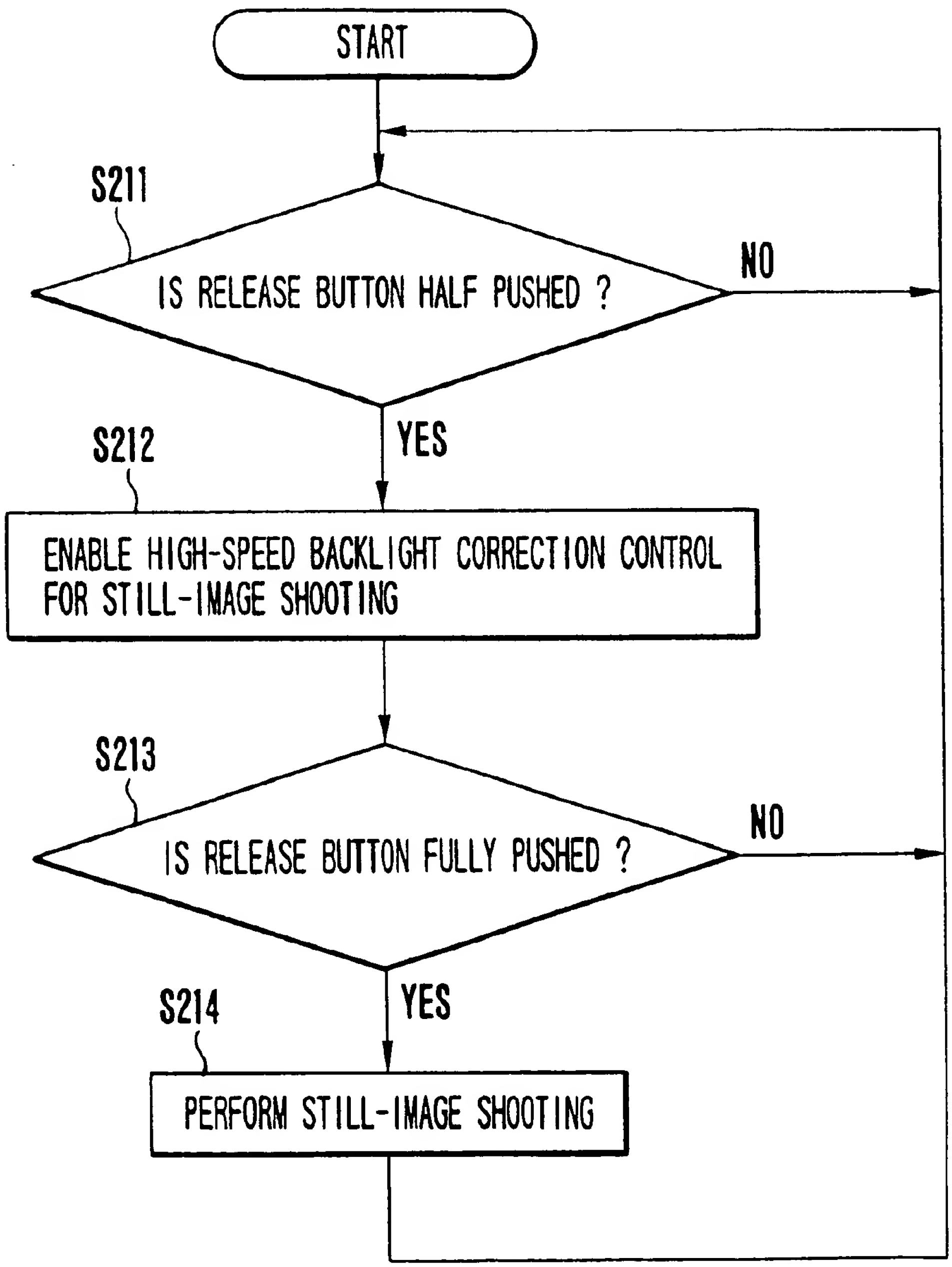

START
S211
IS RELEASE BUTTON HALF PUSHED ?
NO
YES
S212
ENABLE HIGH-SPEED BACKLIGHT CORRECTION CONTROL FOR STILL-IMAGE SHOOTING
S213
IS RELEASE BUTTON FULLY PUSHED ?
NO
YES
S214
PERFORM STILL-IMAGE SHOOTING

FIG.25

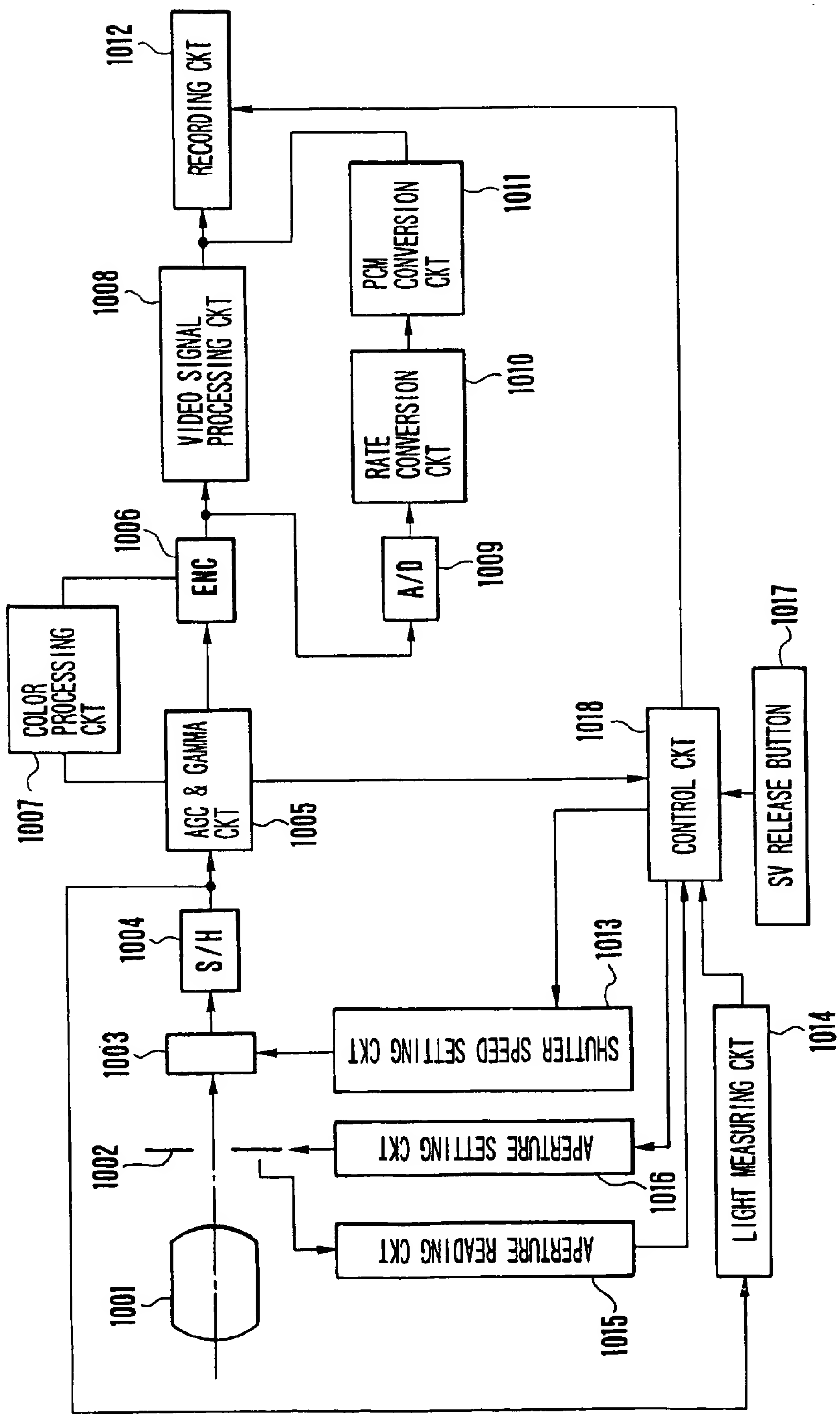

1001
1002
1003
1004
S/H
1005
AGC & GAMMA CKT
1006
ENC
1007
COLOR PROCESSING CKT
1008
VIDEO SIGNAL PROCESSING CKT
1009
A/D
1010
RATE CONVERSION CKT
1011
PCM CONVERSION CKT
1012
RECORDING CKT
1013
SHUTTER SPEED SETTING CKT
1014
LIGHT MEASURING CKT
1015
APERTURE READING CKT
1016
APERTURE SETTING CKT
1017
SV RELEASE BUTTON
1018
CONTROL CKT

FIG.26

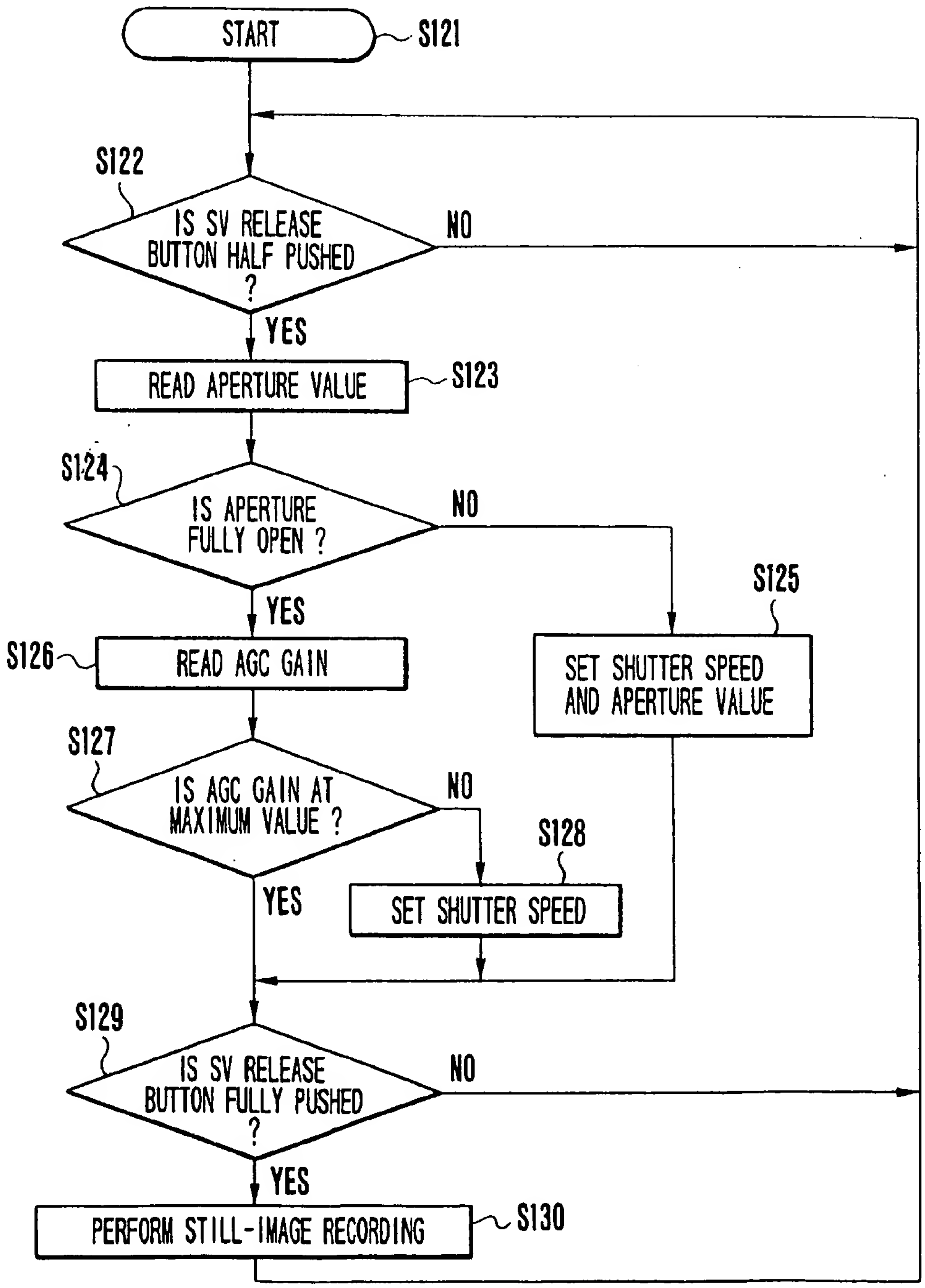

START
S121
S122
IS SV RELEASE BUTTON HALF PUSHED ?
NO
YES
READ APERTURE VALUE
S123
S124
IS APERTURE FULLY OPEN ?
NO
S125
YES
S126
READ AGC GAIN
SET SHUTTER SPEED AND APERTURE VALUE
S127
IS AGC GAIN AT MAXIMUM VALUE ?
NO
S128
YES
SET SHUTTER SPEED
S129
IS SV RELEASE BUTTON FULLY PUSHED ?
NO
YES
PERFORM STILL-IMAGE RECORDING
S130

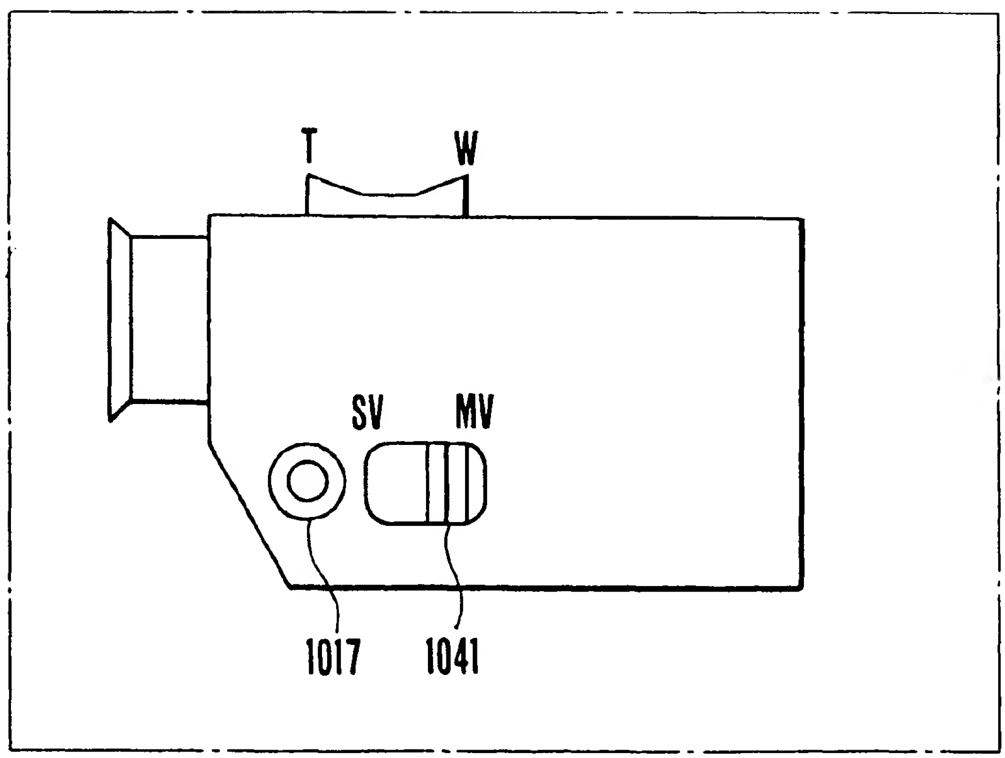
FIG.27(A)

SHUTTER SPEED	APERTURE
1/60 SEC	—
1/125 SEC	OPEN BY ONE STEP
1/250 SEC	OPEN BY TWO STEPS
1/500 SEC	OPEN BY THREE STEPS

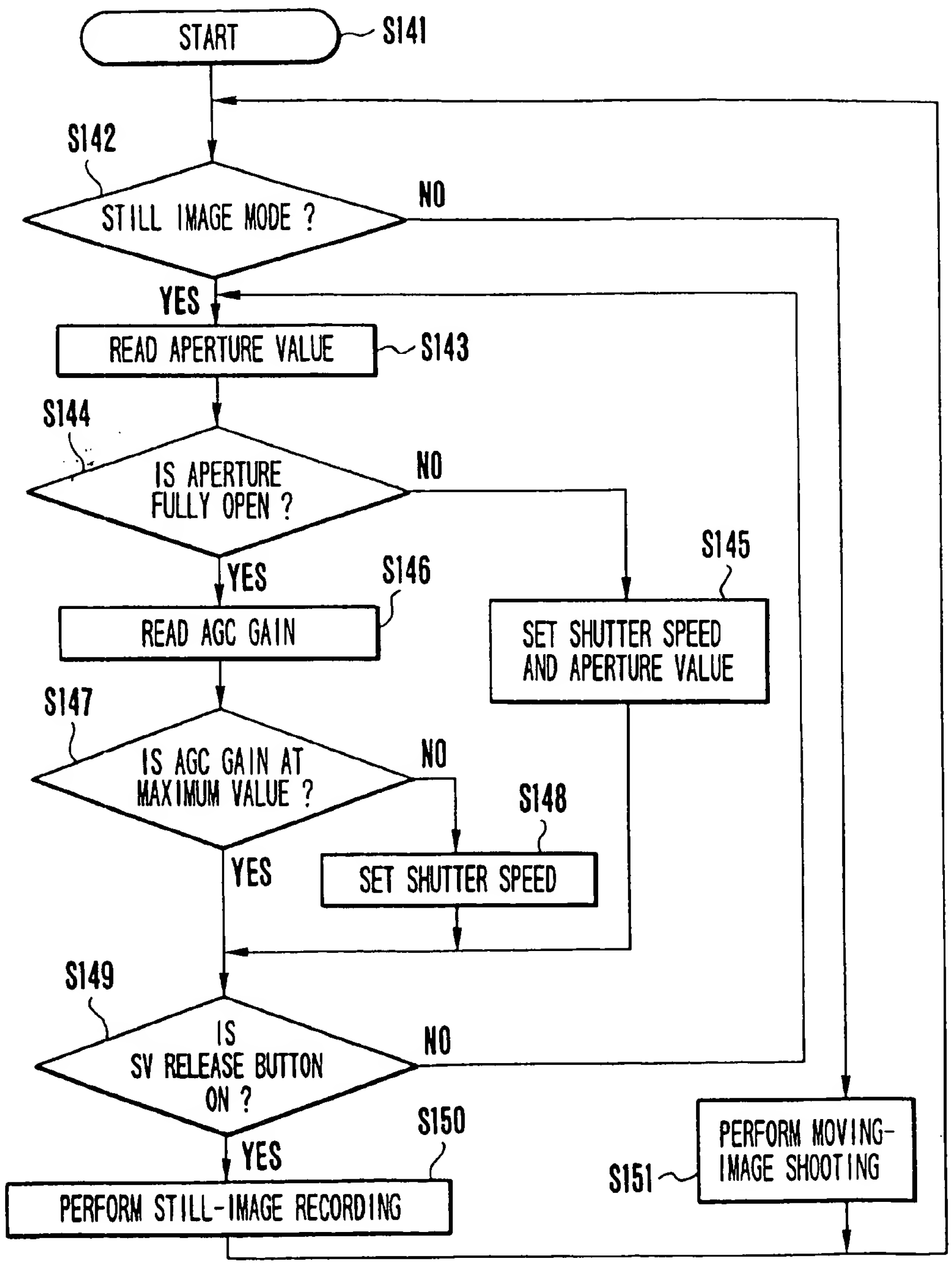
FIG.27(B)

SHUTTER SPEED	AGC GAIN
1/60 SEC	FULL-OPEN APERTURE
1/125 SEC	6 dB UP
1/250 SEC	12 dB UP
1/500 SEC	18 dB UP

FIG. 28



F I G. 29


START
S141
S142
STILL IMAGE MODE ?
NO
YES
READ APERTURE VALUE
S143
S144
IS APERTURE FULLY OPEN ?
NO
S145
YES
S146
READ AGC GAIN
SET SHUTTER SPEED AND APERTURE VALUE
S147
IS AGC GAIN AT MAXIMUM VALUE ?
NO
S148
YES
SET SHUTTER SPEED
S149
IS SV RELEASE BUTTON ON ?
NO
S150
YES
PERFORM STILL-IMAGE RECORDING
S151
PERFORM MOVING-IMAGE SHOOTING

APPARATUS FOR STILL AND MOVING IMAGE RECORDING AND CONTROL THEREOF

This application is a division of application Ser. No. 08/351,740, filed Dec. 8, 1994, U.S. Pat. No. 5,703,638, which is a continuation of Ser. No. 07/948,001, filed Sep. 21, 1992, abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an image pickup apparatus, such as a video camera, arranged to be capable of operating in completely different image shooting modes such as moving image shooting and still image shooting.

2. Description of the Related Art

A demand for high-density recording has recently increased in the field of magnetic recording. To meet this demand, video tape recorders (hereinafter referred to as VTRs) have come to be arranged to perform recording at a higher density by lowering the traveling speed of the tape. The lower traveling speed of the tape, however, brings about a problem which is as follows: In a case where an audio signal is recorded with a fixed head, for example, the quality of reproduced sounds degrades as it is impossible to make the relative speed of the tape and the fixed head sufficiently high. In one of methods for solving this problem, the length of recording tracks to be scanned by a rotary head on the tape is extended to be longer than the conventional length and an audio signal which has been time-base compressed is recorded within the extension area of the tracks. More specifically, this method is carried out in the following manner: While it has been practiced to wrap the magnetic tape at least 180 degrees around a rotary cylinder in the case of a rotary 2-head helical scanning type VTR, the tape is wrapped, according to this method, at least (180+θ) degrees around the rotary cylinder; and an audio signal which has been pulse-code modulated (PCM) and time-base compressed is recorded within the extra wrapped part corresponding to the additional degree θ.

FIG. 1 shows the tape transport system of the VTR of the above-stated kind. FIG. 2 shows recording tracks formed on a magnetic tape by the VTR of FIG. **1**. In FIG. **1**, a reference numeral **1** denotes a magnetic tape. A numeral **2** denotes a rotary cylinder. Numerals **3** and **4** denote heads mounted on the rotary cylinder **2**. In FIG. **2**, A numeral **5** denotes a video signal recording area of the recording track formed on the magnetic tape **1**. A numeral **6** denotes a PCM audio signal recording area of the recording track. The video signal recording area **5** is arranged to be traced by the heads **3** and **4** within the angle range of 180 degrees around the rotary cylinder **2**, and the PCM audio signal recording area **6** is arranged to be traced within the additional angle range of θ around the rotary cylinder **2**.

As one application example of the method of recording a digital signal in another area while a video signal is recorded within one area as mentioned above, a method of recording a still image within the digital signal recording area **6** in the form of a digital signal has been proposed. Information on one still image can be completely recorded on the magnetic tape **1** by scanning a plurality of the PCM signal recording areas **6**. This method not only enables one and the same image pickup apparatus to use one and the same recording medium for still image shooting as well as for moving image shooting but also makes it possible to obtain a still image of a higher picture quality than a still image obtainable by the

conventional VTR by reproducing a video signal from one and the same track by stopping the tape travel.

It has been also proposed to combine a recording apparatus of the above-stated kind with a camera into a camera-integrated type VTR (hereinafter referred to as a video camera) which permits still image shooting as well as moving image shooting.

The video camera of the above-stated kind is provided with various automatic control functions such as an automatic white balance control function and an automatic focus control function for optimum image pickup. To carry out these functions, the video camera is provided also with various moving parts such as an actuator for an optical system, etc.

However, the characteristics of these functions are arranged to be optimum only for moving image shooting in general. It has been, therefore, a shortcoming of the conventional video camera of the above-stated kind that the still image shooting cannot be accomplished in an optimum manner because of such characteristics.

SUMMARY OF THE INVENTION

This invention is directed to the solution of the problem of the prior art. It is, therefore, an object of the invention to provide an image pickup apparatus which is capable of recording still images in an optimum state as well as moving images by itself.

It is another object of the invention to provide an image pickup apparatus which is arranged to permit smooth switching from moving image shooting over to still image shooting.

To attain these objects, an image pickup apparatus which is arranged as an embodiment of this invention comprises: image pickup means arranged to convert image pickup light obtained from an object into an electrical signal; instructing means arranged to give an instruction for moving image shooting or for still image shooting; driving-control means for driving-control over moving image shooting and still image shooting with predetermined different control characteristics; and setting means for setting the different control characteristics according to the instruction of the instructing means.

The embodiment is capable of performing under apposite control conditions not only the moving image shooting but also the still image shooting.

With the control characteristics appropriately set, switchover from the moving image shooting to the still image shooting can be smoothly accomplished.

Further, this invention is not limited to the moving image shooting and the still image shooting but is also applied to any cases where the image pickup is to be performed in any of different modes by a single apparatus.

These and other objects and features of this invention will become apparent from the following detailed description of embodiments thereof taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view showing in outline a tape transport system employed in the conventional magnetic recording apparatus.

FIG. 2 conceptually shows recording tracks formed on a magnetic tape by the magnetic recording apparatus shown in FIG. 1.

FIG. 3 is a block diagram showing the circuit arrangement of a video camera which is arranged according to this invention as a first embodiment thereof.

FIG. 4 is a flow chart showing the procedures for actions to be taken within a shutter control device included in the video camera shown in FIG. 3.

FIG. 5 is a flow chart showing the internal flow of shutter control of FIG. 4 for still image shooting.

FIG. 6 is a flow chart showing the internal flow of shutter control performed for still image shooting in a manner as a modification example of the first embodiment.

FIG. 7 is a block diagram showing the circuit arrangement of a video camera which is arranged according to this invention as a second embodiment thereof.

FIG. 8 is a flow chart showing procedures for shutter control to be taken at the time of still image shooting by a shutter control device shown in FIG. 7.

FIG. 9 is a flow chart showing the internal flow of shutter control performed for still image shooting in a manner as a modification example of the second embodiment.

FIG. 10 is a flow chart showing the internal flow of shutter control performed for still image shooting by another modification example of the second embodiment.

FIG. 11 is a block diagram showing the whole arrangement of a third embodiment of this invention.

FIG. 12 is a flow chart showing the procedures of control to be taken in the still image recording (SV) mode of the third embodiment.

FIG. 13 is a flow chart showing the procedures of control to be taken in the moving image recording (MV) mode of the third embodiment.

FIG. 14 is a flow chart showing procedures for detecting a half-pushed state of a 2-step trigger switch.

FIG. 15 is a flow chart showing the operation of a fourth embodiment of this invention.

FIG. 16 is a flow chart showing the operation of a fifth embodiment of this invention.

FIG. 17 is a block diagram showing the arrangement of a seventh embodiment of this invention.

FIG. 18 is a block diagram showing the arrangement of an eighth embodiment of this invention.

FIG. 19 is a flow chart showing the operation of the circuit arrangement shown in FIG. 18.

FIG. 20 shows the image-plane dividing arrangement of color detecting means shown in FIG. 17.

FIG. 21 is a vector diagram showing the operation of the arrangement shown in FIG. 17.

FIG. 22 is a block diagram showing the circuit arrangement of a magnetic recording/image pickup apparatus arranged as a ninth embodiment of this invention.

FIG. 23 is a block diagram showing the circuit arrangement of a magnetic recording/image pickup apparatus arranged as a tenth embodiment of this invention.

FIG. 24 is a flow chart showing the control procedures of the tenth embodiment of this invention.

FIG. 25 is a block diagram showing an eleventh embodiment of this invention.

FIG. 26 is a flow chart showing the operation procedures of a control circuit shown in FIG. 25.

FIGS. 27(A) and 27(B) show shutter speeds as in relation to aperture values.

FIG. 28 shows the arrangement of a twelfth embodiment of this invention.

FIG. 29 is a flow chart showing the control procedures of the twelfth embodiment of this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following describes embodiments of this invention with the features of them first described in outline as follows:

A magnetic recording apparatus arranged as an embodiment of this invention to be capable of recording a still image along with a moving image is characterized in that the embodiment is provided with detecting means for detecting a release signal for recording a still image, and control means arranged to inhibit any driving-control over a driving part included in a photo-taking optical system when the release signal is detected by the detecting means while the apparatus is in the mode of still image recording.

A magnetic recording apparatus arranged as another embodiment of this invention to be capable of recording a still image along with a moving image is characterized in that the embodiment is provided with detecting means for detecting the state of a camera control action when the apparatus is in the mode of still image recording, and control means arranged to inhibit a release for still image recording when the camera control action is determined to be in a transition period on the basis of a detection signal provided by the detecting means.

In one mode of the above-stated embodiment, the camera control action is considered to be at least one of control actions including white balance control, aperture control and automatic gain control.

In the magnetic recording apparatus which is arranged as the above-stated embodiment and is capable of both moving image recording and still image recording, an actuator provided for driving the optical system is forcibly inhibited from driving when a release is made for still image recording, so that an image shake can be prevented to ensure sharp still image shooting.

Further, in recording a still image with the magnetic recording apparatus which is capable of recording both a moving image and a still image, the operating state of camera control is monitored and a release action is inhibited if the camera control is found to be in a transition period. Therefore, the still image recording action can be prevented from being performed under any condition inapposite to shooting.

The details of the embodiments are as described below with reference to the accompanying drawings:

Embodiment I

FIG. 3 shows the circuit arrangement of a magnetic recording apparatus according to this invention as a first embodiment thereof. FIG. 4 shows the flow of operation procedures to be taken within a shutter control device 320 shown in FIG. 3.

Referring to FIG. 3, a reference numeral 300 denotes a focusing lens group which is provided for forming an object image on an image sensor. A numeral 302 denotes a zooming lens group. The focusing and zooming lens groups 300 and 302 are arranged to be driven respectively by a focusing motor 336 and a zooming motor 332 through a focus driving circuit 334 and a zoom driving circuit 330 in accordance with the instructions of an optical system control device 322. A numeral 304 denotes a compensating lens group. A numeral 306 denotes a shutter which is arranged to be driven

by a shutter driving circuit **324** according to an instruction from a shutter control device **320**. A numeral **308** denotes an iris which is arranged to be operated by an aperture control circuit **326** and an IG meter **328**.

An object image is formed, through the optical system **300**, **302** and **304**, the shutter **306** and the iris **308**, on an image sensor **310**. The image sensor **310** converts the object image into an electrical signal. The electrical signal passes a preamplifier **312** and a camera signal processing circuit **314** to be sent as a video signal to a moving-image recording/still-image recording change-over control circuit **315**.

In the case of moving image recording, the video signal is supplied to a video signal processing circuit **3151** to be converted into a desired form of video signal before it is supplied to a recording device **3155**. In the case of still image recording, the video signal is supplied from the change-over control circuit **315** to an A/D (analog-to-digital) conversion circuit **3152** to be converted into a digital signal. The digital signal thus obtained is converted into a desired form of digital signal through a rate conversion circuit **3153** and a PCM conversion circuit **3154** and is then supplied as a still image recording signal to the recording device **3155**.

A moving-image shooting/still-image shooting mode selection (hereinafter referred to as M/S selection) input part **316** is arranged to supply either a moving image shooting mode selection signal or a still. image shooting mode selection signal, according to a selection made by the photographer, to both the shutter control device **320** and the moving-image recording/still-image recording change-over control circuit **315**. A release device **318** is arranged to supply a release switch on/off signal (hereinafter referred to as a release signal) to the shutter control device **320** when a release button is pushed by the photographer.

The shutter control device **320** which uses a microcomputer is arranged to control the shutter speed to make it most apposite to the still image shooting or to the moving image shooting and also to control the optical system, the signal processing system and the recording device in accordance with input signals which include the above-stated M/S selection signal and the release signal. Further, the characteristics of these control actions are stored as programs in a memory within the shutter control device **320**. In accordance with the selection signal from the above-stated M/S selection input part **316**, the control is carried out by calling an applicable program stored.

Next, referring to FIG. **4**, the flow of operation which is to be performed within the shutter control device **320** of FIG. **3** on the basis of the programs stored in the memory is described as follows:

At a step **400**: A check is made for detection of the M/S selection signal of the M/S selection input part (moving-image shooting/still-image shooting mode selection input part) **316**. In other words, in a case where a mode selecting operation is performed by the photographer to select the moving image shooting mode or the still image shooting mode, the mode as selected is detected from the M/S selection signal and the flow of control shifts to an applicable process.

If the moving image shooting mode is found to have been selected at the step **400**, the flow comes to a step **402**. At the step **402**: The release signal of the release device **318** is checked for its on/off state. If the release signal is found to be on, the process of the moving image shooting is judged to have begun and the flow comes to a next step **404**. At the step **404**: Shutter control is actually performed in a manner suited for the moving image shooting. In a case where the still image shooting mode is found to have been selected at the step **400**, the flow comes to a step **406**. At the step **406**: The release signal of the release device **318** is checked for its on/off state. If the release signal is found to be on, the shutter action is judged to have begun and the flow comes to a step **408**. At the step **408**: Shutter speed is controlled for the still image shooting, and other related control actions are also performed. Since the process of the step **408** constitutes an essential part of this invention, its details will be described later.

Upon completion of the shutter control for the moving image shooting or-the still image shooting, the flow comes back to the step **400** for detection of the moving-image/still-image shooting mode selection signal.

Referring to the flow chart of FIG. **5**, the details of a shutter control routine of the step **408** of FIG. **4** for the still image shooting are as follows: At a step **500**: With the shutter judged to be on, a check is made to find if each of the optical system actuators is in action. If not, the flow comes to a shutter control step **506**. If the actuator is judged to be in action, the flow comes to a step **502** for an actuator stopping routine, which is executed as described below:

At the step **502**: If the focusing lens group **300** is moving, the lens group **300** is forcibly brought to a stop. At a next step **504**: If the zooming lens group **302** is in action while the shutter is on, the zooming lens group **302** is brought to a stop. The flow then shifts from the step **504** to the shutter control step **506**. At the step **506**: The still image shooting is carried out by driving the shutter **306** at a predetermined shutter speed.

At a step **508**: A check is made to find if the actuator was judged to be in action and forcibly brought to a stop at the step **500**. If not, the flow comes out of this routine. If so, the flow comes to an optical system restarting step **510**. At the step **510**: After the end of the still image shooting, if the actuator is found to have been moving before it is brought to a stop, the actuator is again caused to drive the applicable lens group on the same condition as the condition under which the control over the focusing lens group **300** or the zooming lens group **302** is brought to a stop.

As described above, with the release button turned on by the photographer in the still image shooting mode, the control operation is performed to forcibly bring the focusing lens group and the zooming lens group to a stop. Therefore, conditions inapposite to shooting such as changes in the angle of view and in the extent of blur of the image picked up due to the movement of the optical system resulting from the release operation can be prevented. Further, since the optical system is movable again, after the still image shooting, under the same condition as before. Therefore, any unnatural shot that results from the forced stoppage mentioned above can be minimized. In other words, the arrangement of this embodiment prevents an image shake and enables the video camera of the kind capable of recording both a moving image and a still image to give a sharp still image shot because the optical system actuators for the focusing and zooming lens groups are forcibly brought to a stop for still image shooting.

Modification Example of Embodiment I

In the case of the first embodiment of this invention described above, the actuators of the optical system are arranged to be brought to a stop when the release device is turned on. However, the invention is not limited to this arrangement. This arrangement may be changed, as indi-

cated at the step **602** of FIG. **6**, to attract the attention of the photographer by displaying a warning while the actuators are in action. It is also possible to arrange the iris to be brought to a stop the instant the actuators are brought to a stop.

Embodiment II

FIG. **7** shows the circuit arrangement of a magnetic recording apparatus which is arranged as a second embodiment of this invention. The arrangement is similar to that of the first embodiment shown in FIG. **3**. However, the zooming lens group **302**, the compensating lens group **304**, the zoom driving circuit **330** and the motor **332** are omitted from the second embodiment. Further, in the case of the second embodiment, control signal exchange is not particularly necessary between the shutter control device **320** and the optical system control device **322**. The shutter control device **320** is arranged to receive an automatic white balance (AWB) control state signal from the camera signal processing circuit **314**. The AWB control state signal indicates the state of changes taking place in the AWB control. Input signals to the shutter control device **320** include a moving-image shooting/still image shooting (M/S) mode selection signal, a release signal, the AWB control state signal, etc. In accordance with the input signals, the shutter control device **320** controls the shutter and the recording device in a manner most apposite to still image shooting or to moving image shooting.

The flow of the operation procedures to be taken within the shutter control device **320** of FIG. **7** is similar to the flow shown in FIG. **4**. However, the details of the process of the shutter control routine to be executed for still image shooting at the step **408** differ from the first embodiment. The details of this shutter control routine for still image shooting are described below with reference to FIG. **8** which is a flow chart:

At a step **700**: The above-stated AWB control state signal is checked to find if the state of change taking place in the AWB control is above a given level. In other words, a check is made to find if the AWB control is in a transition period. If so, the flow of control is inhibited from coming to a next step **702** which is a shutter driving routine until the AWB control comes to an end. If the AWB control is judged to be in a normal state at the step **700**, the flow comes to the step **702** for the shutter driving routine. At the step **702**: When still image shooting is judged to be possible, the still image shooting is carried out by driving the shutter **306** at a predetermined shutter speed.

The second embodiment is thus arranged to monitor the AWB control state when a release button (or device) is turned on in the still image shooting mode; and to inhibit the shutter operation if the AWB control is in a transition period. Therefore, a still image can be prevented from being recorded in an inapposite state when a color on the image plane differs from the actual color of the object. In other words, with the second embodiment arranged to inhibit a release action for still image shooting according to the AWB control state, the color of the still image is effectively prevented from differing from the actual color. This arrangement enables the video camera of the kind capable of recording both moving and still images to ensure sharp still image shots.

Modification Example of Embodiment II

The second embodiment of the invention described above is arranged to allow or inhibit the release action in accordance with the AWB control state signal. However, the invention is not limited to this arrangement. For example, this arrangement may be changed to allow or inhibit the release action according to an aperture control state signal indicating the state of aperture control as shown at a step **800** in FIG. **9** which is a flow chart. In the case of this modification, the release action is inhibited when the state of aperture control changes to more than a given extent. It is also possible to inhibit the release action when automatic gain control (AGC) changes to more than a given extent as shown at a step **900** in FIG. **10** which is also a flow chart.

Further, it is of course possible to arrange a magnetic recording apparatus by combining the first and second embodiments described in the foregoing.

The arrangement of each of the embodiments described above gives the following advantages:

(1) Since the magnetic recording apparatus of the kind capable of recording both moving and still images is arranged to forcibly inhibit the actuators of the optical system from performing their driving actions upon detection of the on-state of the release device in the still image recording mode, an image shake can be prevented to ensure a sharp still image shot.

(2) The magnetic recording apparatus of the kind capable of recording both moving and still images is arranged to monitor the operating state of camera control at the time of still image shooting and to inhibit the release action when the state of camera control is found to be in a transition period. Therefore, still images can be prevented from being recorded under a condition inapposite to still image shooting.

The following describes in detail further embodiments of this invention:

Embodiment III

FIG. **11** is a block diagram showing the overall arrangement of a third embodiment of this invention. The hardware arrangement shown in FIG. **11** and described in the following applies not only to the third embodiment but also applies in common to other embodiments which will be described after the third embodiment.

Referring to FIG. **11**, a photo-taking lens system **101** includes a focusing lens which is provided for adjustment of focus. An iris **102** is arranged to control the quantity of incident light. An image sensor **103** is made of a CCD or the like and is arranged to photoelectrically convert into an image signal an object image formed on its image pickup plane by the focusing lens **101**.

The illustration further includes a sample-and-hold (S/H) circuit **104**; a camera signal processing circuit **105** which is arranged to convert the output of the S/H circuit **104** into a TV signal; a video signal processing circuit **106** which is arranged to output a moving-image recording (hereinafter referred to as MV) signal; an A/D conversion circuit **107** which converts the TV signal into a digital TV signal; a rate conversion circuit **108** which is arranged to compress the digital TV signal; a PCM conversion circuit **109** which is arranged to output a still image recording (hereinafter referred to as SV) signal which has been PCM-converted; and a recording circuit **110**.

A focus detection circuit **111** is arranged to detect the focused state of an object, for example, by extracting a high-frequency component from the video signal outputted from the camera signal processing circuit **105**. An SV/MV mode selection switch **112** is arranged to set the recording

mode of the apparatus either in an SV (still image recording) or an MV (moving image recording) mode. A two-step type trigger switch 113 (hereinafter referred to simply as the trigger) is arranged to give an instruction to allow or inhibit an automatic focusing (hereinafter referred to as AF) action and also to give an instruction for recording.

A control circuit 114 is arranged to output an instruction for focus control according to the output of the focus detection circuit **111**; to designate the recording mode according to the output of the SV/MV mode selection switch **112**; and to control and allow or inhibit the execution of recording and the AF action according to the output of the trigger **113** (indicating an open state, a half-pushed state or a fully-pushed state of the trigger **113**). A driving motor **115** is arranged to carry out the focus control instructions given from the control circuit **114** as to the rotating direction, rotating speed, rotation and stop of the focusing lens **101**.

FIG. **12** is a flow chart showing the flow of control to be performed in the SV mode. At a step S1: The recording mode is checked for the SV mode. If it is found to be the SV mode, the flow comes to a step S2. At the step S2: A check is made to find if the trigger is open. If so, the flow comes to a step S3 to have the AF action performed before the flow comes to a step S4. If not, the flow directly comes to a step S4. At the step S4: A check is made to find if the trigger is in a half-pushed state. If not, the flow comes to a step S5. At the step S5: A check is made to find if the trigger is in a fully-pushed state. In the case of the fully-pushed state, the flow comes to a step S6 to inhibit the AF action. At a step S9: The object image formed on the image pickup plane is taken in. A signal thus obtained from the image sensor **103** is subjected to the above-stated processes including the A/D conversion, the rate conversion and the PCM conversion. After completion of these processes, a still image is recorded.

If the trigger is found not in the fully-pushed state at the step S5, the flow comes back to the step S3 to allow the AF action to be performed. In this instance, the trigger is in its open state. If the trigger is found to be in the half-pushed state at the step S4, the flow comes to a step S7 to inhibit the AF action. The flow then comes to a step S8. At the step S8: A check is made to find if the trigger is in the fully-pushed state. If not, the flow comes back to the step S2 to find if the trigger is open. If the trigger is found to be in the fully-pushed state at the step S8, the flow comes to the step S6 to inhibit the AF action. After that, the flow comes to the step S9 to take in the object image formed on the image pickup plane and to have a still image recorded in the same manner as mentioned above.

FIG. **13** is a flow chart showing the flow of control procedures to be taken when the recording mode is the MV mode. At a step S11: A check is made to find if the recording mode is the MV mode. If so, the flow comes to a step S12. At the step S12: The trigger is checked to find if it is open. If so, the flow comes to a step S13 to allow the AF action to be carried out. If not, the flow comes to a step S14. At the step S14: A check is made to find if the trigger is in the half-pushed state. If not, the flow comes to a step S15. At the step S15: A check is made to find if the trigger is in the fully-pushed state. If so, the flow comes to a step S16 to allow the AF action to be carried out. After that, the flow comes to a step S19 to have the object image on the image pickup plane subjected to the above-stated video signal processing action before the moving image thus obtained is recorded.

If the trigger is found to be not in the fully-pushed state at the step S15, the flow comes back to the step, S13 to allow

the AF action to be carried out. The trigger is in the open state in this instance. At the step S14: A check is made to find if the trigger is in the half-pushed state. If so, the flow comes to a step S17 to inhibit the AF action. At a step S18: A check is made to find if the trigger is in the fully-pushed state. If not, the flow comes back to the step S12 to find if the trigger is open.

In a case where the trigger is found to be in the fully-pushed state at the step S18, the flow comes to the step S16 to allow the AF action to be carried out. The flow then comes to the step S19 to have the object image on the image pickup plane recorded in the moving image recording mode. During the process of recording, the flow comes to a step S20. At the step S20: A check is made to find if the trigger is in the half-pushed state. If so, the flow comes to a step S21 to inhibit the AF action. If not, the flow comes to a step S22. At the step S22: A check is made to find if the trigger is open. If so, the flow comes back to the step S16 to allow the AF action to be carried out and then comes to the step S19 to perform the moving image recording. If not, the flow comes to a step S23. At the step S23: A check is made again to find if the trigger has been fully pushed. If not, the recording is allowed to continue. If the trigger is found to have been fully pushed, the flow comes to a step S24 to bring the recording to a stop.

FIG. **14** is a flow chart showing the flow of control procedures for detecting the half-pushed state of the trigger while preventing chattering. The states of the trigger other than the half-pushed state can be detected by procedures similar to this flow of control. Referring to FIG. **14**, a check is made at a step S31 to find if the trigger is in the half-pushed state. If so, the flow comes to a step S32 to start a timer. At a step S33: The length of time is counted until the time count of the timer comes to an end. The sensitivity of reading the half-pushed state of the trigger is determined by the time thus measured. The time length set for the SV mode differs from the the time length set for the MV mode. For example, in the event of the SV mode, the time is set to be shorter than for the MV mode to read the half-pushed state of the trigger with a higher sensitivity. In the MV mode, the time may be set to be longer by taking into consideration the possibility of pushing the trigger from its open state directly to the fully-pushed state for recording. The length of time count thus can be variously set according to the mode and the control function.

Upon completion of the count of the timer at the step S33, the flow comes to a step S34. At the step S34: If the trigger is found to be still in the half-pushed state even after the lapse of the time set at the timer, the flow comes to a step S35. At the step S35: The half-pushed state of the trigger is detected.

Embodiment IV

In the SV mode, it is not always necessary to carry out the AF action when the two-step trigger is open and to inhibit the AF action with the trigger in the half-pushed state like in the case of the third embodiment.

Therefore, a fourth embodiment is arranged to inhibit the AF action when the two-step trigger is open and to carry out the AF action when the trigger is in the half-pushed state as shown in FIG. **15**, which is a flow chart. Referring to FIG. **15**, the fourth embodiment is described as follows: At a step S41: A check is made for the recording mode. If the recording mode is the SV mode, the flow comes to a step S42. At the step S42: The trigger is checked to see if it is open. If so, the flow comes to a step S43 to inhibit the AF

action. If not, the flow comes to a step S44 to see if the trigger is in the half-pushed state. If the trigger is not in the half-pushed state, the flow comes to a step S45. At the step S45: A check is made to see if the trigger is in the fully-pushed state. If so, the flow comes to a step S46 to inhibit the AF action. The flow then comes to a step S49. At the step S49: An object image on the image pickup plane is taken in. Still image recording is carried out after the processes of the A/D conversion, rate conversion and PCM conversion are performed as described in the foregoing. If the trigger is found not in the fully-pushed state at the step S45, the flow comes back to the step S43 to inhibit the AF action. In this instance, the trigger is in its open state. If the trigger is found to be in the half-pushed state at the step S44, the flow comes to a step S47 to carry out the AF action. The flow then comes to a step S48. At the step S48: A check is made to find if the trigger is in the fully-pushed state. If not, the flow comes back to the step S42 to find if the trigger is open. If the trigger is found to be in the fully-pushed state at the step S48, the flow comes to the step S46 to inhibit the AF action. The flow then comes to the step S49 to take in the object image formed on the image pickup plane for still image recording.

Embodiment V

If the recording mode is the MV mode, it is possible to allow or inhibit the AF action according to the state of the AF action performed up to that point of time (the open or half-pushed state of the trigger) in performing recording with the trigger fully pushed.

Therefore, a fifth embodiment is arranged as shown in FIG. 16 which is a flow chart. Referring to FIG. 16, the recording mode is first checked at a step S51 to find if it is the MV mode. If so, the flow comes to a step S52 to find if the trigger is open. If so, the flow comes to a step S53 to allow the AF action to be carried out. If not, the flow comes to a step S54 to find if the trigger is in the half-pushed state. If the trigger is found not in the half-pushed state, the flow comes to a step S55. At the step S55: A check is made to find if the trigger is in the fully-pushed state. If so, the flow comes to a step S56 to have the moving image recording performed. If not, the flow comes back to the step S53 to allow the AF action to be carried out. At this time, the trigger is open.

If the trigger is found to be in the half-pushed state at the step S54, the flow comes to a step S57 to inhibit the AF action. The flow then comes to a step S58 to find if the trigger is in the fully-pushed state. If not, the flow comes back to the step S52 to find if the trigger is open. If the trigger is found to be in the fully-pushed state at the step S58, the flow comes to the step S56 to have the moving image recording performed with the AF action left inhibited.

During the process of recording, the flow comes to a step S59. At the step S59: A check is made to find if the trigger is in the half-pushed state. If so, the flow comes to a step S60 to inhibit the AF action. If not, the flow comes to a step S61. At the step S61: A check is made to find if the trigger is open. If not, the flow comes back to the step S56 to perform the moving image recording. If so, the flow comes to a step S62 to allow the AF action to be carried out. The flow then comes to a step S63. At the step S63: A check is made to find again if the trigger is in the fully-pushed state. If not, the recording is allowed to continue. If so, the flow comes to a step S64 to bring the recording to a stop.

Embodiment VI

The two-step trigger may be arranged to have no function in its half-pushed state, that is, to act as a one-step trigger switch, when the MV mode is selected for recording. In the case of a sixth embodiment of this invention, the trigger is arranged to be opened and fully pushed for recording without having the function of allowing or inhibiting the AF action.

The third to sixth embodiments described above are arranged to give instructions for allowing/inhibiting the AF action and for recording by means of one operation means. Therefore, the operability of the apparatus for recording and allowing/inhibiting the AF action can be greatly enhanced to widen shooting conditions. Further, the embodiments permit the intention of the photographer to be more easily reflected in the images recorded.

Next, other embodiments which are arranged with attention given to white balance control are described.

As mentioned in the foregoing, the control actions which must have different characteristics for still image shooting from characteristics for moving image shooting include the white balance control action.

In shooting a still image, the image of the object to be shot is instantly frozen. In order to secure a shutter opportunity, a white balance correcting action is desired to be quickly performed without any error.

On the other hand, in the case of moving image shooting, the images of the object are temporally continuing. In this case, although the white balance correction is also preferably performed within a short period of time, an excessively high-speed white balance correction tends to cause an overshot correction. The overshooting then might result in a repetitive correction, which causes the continuous images to give a disagreeable impression. In view of this, for the moving image shooting, the white balance correction is desired to be performed smoothly rather than at a high speed.

Therefore, if the white balance correction or adjustment is controlled in the same manner for both the moving image shooting and the still image shooting, color adjustment cannot be adequately accomplished for each of the different modes of shooting.

In view of this problem, each of the embodiments described below is arranged to enable an image pickup apparatus to accomplish white balance control appositely to the characteristic of still image shooting and that of moving image shooting.

The arrangement of each of these embodiments is summarized as follows: An image pickup apparatus of the kind capable of performing both moving image shooting and still image shooting comprises: gain control means for controlling an amplification gain of a color signal obtained from an image sensor; color detecting means for detecting a color of an object on the basis of a signal obtained from the gain control means; gain control signal forming means for forming a gain control signal to be supplied to the gain control means according to an output signal of the color detecting means; mode detecting means for detecting that the apparatus is set in a still image shorting mode; and control means arranged to vary a mode of control over the gain control signal forming means in response to an output of the mode detecting means.

At the time of still image shooting, this arrangement enables the apparatus to accomplish a white balance correcting action at a high speed by detecting the selection of the still image shooting mode and by increasing the amount of correction of the white balance correcting action by the gain control means. The details of these embodiments are described as follows:

Embodiment VII

FIG. 17 is a block diagram showing a seventh embodiment of this invention. The illustration includes an A/D conversion circuit **30**; a rate conversion circuit **31**; a PCM conversion circuit **32**; a recording circuit **33**; a white balance adjustment on/off switch **34**; a shooting mode selection switch **35** for selection of either a moving image recording (MV) mode or a still image recording (SV) mode; and a control circuit **36**. The control circuit **36** is arranged to detect the shooting mode; to cause the recording circuit **33** to perform recording in the detected mode; and to cause a white balance correcting action to be performed if the white balance on/off switch **34** is on.

The illustration further includes an image sensor **41**; a luminance/chrominance signal forming part **42**; a gain control part **43** for a red (R) signal; a gain control part **44** for a blue (B) signal; a color-difference signal forming part **45**; and an encoder **46**.

A dividing signal generator **16** is arranged to generate a dividing signal for dividing color-difference signals. The dividing signal generator **16** outputs, from a terminal P for every vertical scanning period V, a pulse for taking out a portion of each color-difference signal obtained from within the image plane. The dividing signal generator **16** also outputs a reset pulse from a terminal Q' at the end of every vertical scanning period V. Dividing parts **17** and **18** are arranged to divide respectively the color-difference signals R-YL and B-YL by outputting dividing pulses from a terminal P' for operating an analog switch or the like.

An averaging part **19** is arranged to average the divided R-YL signals. An averaging part **20** is arranged to average the divided B-YL signals. The averaged signals are inputted to a microcomputer **29** through terminals P and Q.

An A/D (analog-to-digital) converter **21** is arranged to convert the averaged B-YL signal coming from the terminal P into a digital value. An A/D converter **22** is arranged to convert the averaged R-YL signal coming from the terminal Q into a digital value. A color discrimination part **23** is arranged to discriminate the colors of the divided parts on the basis of the output values of the A/D converters **21** and **22**, and to control level adjustment parts **24** and **25** according to information obtained as a result of the discrimination.

The level adjustment part **24** is arranged to adjust the value obtained from the A/D converter **21** according to a signal from the color discrimination part **23**. The level adjustment part **25** is arranged to adjust the value obtained from the A/D converter **22** according to the signal from the color discrimination part **23**. A correction signal control part **26** is arranged to control a white balance correction output on the basis of the outputs (R-YL)' and (B-YL)' of the level adjustment parts **24** and **25**. A D/A (digital-to-analog) converter **27** is arranged to convert the output value of the correction signal control part **26** from a digital value to an analog value and to output a white balance correction signal B. cont. A D/A converter **28** is likewise arranged to convert the output of the correction signal control part **26** and to output a white balance correction signal R. cont.

In FIG. **17**, the circuit elements **16** to **23** constitute color detection means for detecting the color of the object. Next, the image plane dividing action of the color detection means is described as follows:

In a case where the image plane is to be divided into **20** blocks as shown in FIG. **20**, the image plane is divided in the order of numbers indicated in FIG. **20**. The averaging parts **19** and **20** are arranged to average the color-difference signals of the divided blocks, to amplify the average color-difference signals and to supply them as data to the microcomputer **29**. When the data is taken in by the A/D converters **21** and **22** of the microcomputer **29**, the dividing signal generator **16** outputs a reset pulse to reset the contents of the averaging parts **19** and **20**.

The above-stated actions are performed for every field and the data of each division (block) of the image plane is supplied to the microcomputer **29** for every field. The microcomputer **29** performs a white balance correcting action on the basis of the divided data.

The color discrimination part **23** shown in FIG. **17** acts as follows: The data of the A/D-converted color-difference signals R-YL and B-YL is inputted to the color discrimination part **23**. The values of the input data are compared respectively with reference values Rref and Bref which indicate the white levels preset within the color discrimination part **23** for the color-difference signals R-YL and B-YL. The color discrimination part **23** then judges what kind of color is existing in each of the divided blocks on the basis of the result of comparison. For the sake of simplification, each of the reference values Rref and Bref is assumed to be 0. The values of R-YL and B-YL data of a certain block are assumed to be r1 and −b1, for example. If these values are in the relation of r1<b1 and r1>0, the vectorial position of the color of this block is considered to be at a point Ye as shown in FIG. **21**. In this instance, such signals that are for multiplying the color-difference signal B-YL by x to make it into −b2 and the color-difference signal R-YL by y to make it into −r2 are supplied respectively to the level adjustment parts **24** and **25**.

Referring to FIG. **21** which is a vectorial representation, with the above-stated action performed, the signal at the point Ye is converted into a signal of a point G before it is supplied to the correction signal control part **26**. At the correction signal control part **26**, gain control signals are generated according to the input signals and the white level reference values Rref and Bref. The gain control signals are supplied through the D/A converters **27** and **28** to the gain control parts **43** and **44** for a white balance correcting action.

As described above, in the case of this embodiment, the circuit elements **24** to **28** constitute signal forming means for the gain control to be performed by the gain control parts **43** and **44**. The signal located at the point Ye of the vectorial representation of FIG. **21** is converted into the signal located at the point G before it is inputted to the correction signal control part **26**. At the correction signal control part **26**, gain control signals are generated on the basis of the input signals and the white level reference values Rref and Bref. The white balance correcting action is performed by supplying the gain control signals to the gain control parts **43** and **44** through the D/A converters **27** and **28**.

In this instance, the control circuit **36** is arranged as follows: In a case where the output of the mode selection switch **35** indicates the moving image shooting mode, the control circuit **36** causes the correction gain of the correction signal control part **26** to be set at a low value in such a way as to have the correction value output little by little until an apposite white level is attained, so that the white balance correcting action can be smoothly accomplished. In the event of the still image shooting mode, the correction gain of the correction signal control part **26** is caused to be set at a high value in such a way as to make correction instantly up to the apposite white level, so that the white balance correcting action can be speedily accomplished.

Embodiment VIII

FIG. **18** is a block diagram showing an eighth embodiment of this invention. In FIG. **18**, parts which are the same

or similar to those shown in FIG. 17 are indicated by the same reference numerals. As shown in FIG. 18, the eighth embodiment is provided with an SV release button 37 for SV (still image shooting). When the SV release button 37 is operated, the control circuit 36 detects the still image shooting mode. Under the release condition, therefore, the white balance correcting action is performed in the still image shooting mode to permit a high-speed white balance correcting action.

FIG. 19 is a flow chart showing the operation of the circuit arrangement of FIG. 18. Referring to FIG. 19, a check is made for a half-pushed state of the release button at a step S111. If the release button is judged to be in the half-pushed state, the flow comes to a step S112. At the step S112: The white balance correcting action is allowed to be accomplished at a high speed for the still image shooting. At a next step S113: A check is made to find if the release switch is fully pushed. If so, the flow comes to a step S114. At the step S114: A still image is recorded by A/D converting, rate converting and PCM converting a video signal.

Each of the seventh and eighth embodiments is arranged to permit adequate shooting and recording by detecting the shooting mode and by performing white balance correction control either at a high speed adapted for the still image shooting in the still image shooting mode or in a smooth manner adapted for the moving image shooting in the moving image shooting mode.

The following describes some embodiments of the invention that are arranged with attention given to backlight correction control:

Similar to the above-stated white balance control, the characteristic of the backlight correction control required for the still image shooting differs from the characteristic required for the moving image shooting.

In cases where the luminance of the object greatly differs from that of the background like in the case of a backlight shot, the image obtained under such a condition becomes unnatural with the object image excessively darkened. To prevent this, there has been proposed a light measuring method of measuring light by attaching a weight to a part of the image plane such as the inside of a frame set in the central part where the probability of having a main object image located on the image plane is high. Another method proposed for this purpose is an evaluative light measuring method. According to that method, light is evaluatively measured by using a plurality of light measuring frames arranged to differ in area from each other within the image plane, and light measurement information is corrected according to the result of evaluation.

Since, in the case of still image shooting, the object image is instantly frozen, the backlight correcting action must be accomplished at a high speed in order to secure a shutter opportunity. The backlight correcting action must be quickly and accurately controlled in shooting a still image. On the other hand, in the case of moving image shooting, the object is temporally continuous. Although the backlight correction control is preferably performed also in a short period of time, an excessively high-speed backlight corection tends to overshoot a desired exposure or to cause a repetitive control action due to the overshooting. Continuous images obtained under such a condition tend to give a disagreeable impression. Hence, in the case of the moving image shooting, the backlight correction control is preferably performed in a smooth manner rather than at a high speed. Therefore, if the backlight correction control is applied in the same manner both to moving image shooting and to still image shooting, it is hardly possible to adequately perform the control for each of the two different shooting modes.

In view of the above-stated problem, the embodiments described below are arranged to detect the shooting mode selected and, in the event of the still image shooting mode, to increase the amount of backlight correction to be made at a time, so that the backlight correction control can be accomplished at a high speed.

The arrangement of each of these embodiments is summarized as follows: A magnetic recording image pickup apparatus capable of selectively recording either moving images or still images comprises: light measuring means arranged to perform weighted light measurement on the basis of a light measuring area set in a specific position within an image plane; level detecting means for detecting luminance signal levels obtained from a plurality of light measuring areas set within the image plane; determining means for determining a backlight condition of an object on the basis of an output of the level detecting means; correcting means for correcting, on the basis of the result of determination made by the determining means, a measured light signal obtained from the light measuring means under a backlight shooting condition; mode detecting means for detecting a still image shooting mode; and control means for performing control in such a way as to make the amount of correction to be made at a time greater than the amount of correction for a moving image shooting when the still image shooting mode is detected by the mode detecting means.

The embodiment is arranged to detect the mode of shooting, to perform the backlight correction control at a high speed by increasing the amount of correction to be made at a time in the event of the still image shooting mode, and to perform the backlight correction control as smoothly and accurately as possible by decreasing the amount of correction to be made at a time in the case of the moving image shooting mode. Therefore, the backlight correction control can be accomplished appositely to each of the different shooting modes.

The details of the above-stated embodiments are described below with reference to the drawings:

Embodiment IX

FIG. 22 shows the circuit arrangement of a ninth embodiment of this invention. The illustration includes an A/D conversion circuit 214; a rate conversion circuit 215; a PCM conversion circuit 216; a recording circuit 217; a mode selection switch 218 for switching the shooting mode between an MV (moving image shooting) mode and an SV (still image shooting) mode; and a control circuit 219. The control circuit 219 is arranged to detect the shooting mode and to cause the recording circuit 217 to perform recording in the mode detected.

The illustration of FIG. 22 further includes a photo-taking lens 201; an iris 202 which is arranged to control the quantity of incident light; an image sensor 203 which is a CCD (charge-coupled device) or the like; a buffer amplifier 204; an AGC (automatic gain control) circuit 205; a light measuring circuit 208 which is arranged to measure light on the basis of the output of the buffer amplifier 204 according to a fixed-frame signal coming from a fixed-light-measuring-frame signal generating circuit 210 and a correction signal coming from a backlight correction circuit 212; and another light measuring circuit 209 which is arranged likewise to measure light on the basis of the output of the AGC circuit 205. The fixed-light-measuring-frame signal generating circuit 210 is arranged to gate a video signal to

pass only a video signal portion that corresponds to the position of a light measuring frame imaginarily set on the image plane; and, as a result of gating, to generate a fixed-light-measuring-frame signal for measuring light on the basis of a signal obtained from within the light measuring frame.

An iris driving circuit **207** is arranged to control the amount of aperture by driving the iris **202** according to the output of the light measuring circuit **208**. A reference numeral **206** denotes an encoder circuit. A terminal **211** is arranged to receive a composite synchronizing signal which is used for setting the light measuring frame.

With the embodiment arranged as described above, incident light which comes through the lens **201** and the iris **202** to fall on the image sensor **203** is photoelectrically converted into an electrical signal. This electrical signal is supplied to the AGC circuit **205** to be subjected to a signal processing action including gain control, etc. The signal is divided into a luminance signal and color-difference signals. The signal from the AGC circuit **205** is inputted to the encoder (ENC) circuit **206**. The signal inputted to the encoder circuit **206** is also inputted to the backlight correction circuit **212**. The backlight correction circuit **212** determines the state of backlight by comparing the output level of the AGC circuit **205** with a reference value. The circuit **212** sends a correction signal indicating a correction amount decided according to the result of comparison to the light measuring circuits **208** and **209**. Upon receipt of the correction signal, the light measuring circuits **208** and **209** drive the iris **202** and the AGC circuit **205**. As a result, the light measurement is accomplished with the adverse effect of a backlight condition adequately corrected, so that the object image can be prevented from being excessively darkened.

In this instance, the control circuit **219** operates according to the shooting mode detected from the mode selection switch **218** to cause the backlight correction circuit **212** to lower the amount of correction to be made at a time in such a way as to have the amount of correction outputted little by little up to a desired amount of exposure if the moving image shooting mode is selected. Therefore, the backlight correction can be smoothly carried out in the moving image shooting mode.

If the mode detected from the mode selection switch **218** is the still image shooting mode, the control circuit **219** causes the backlight correction circuit **212** to increase the amount of correction to be made at a time in such a way as to have the correction instantly carried out up to an amount apposite to a desired exposure. The backlight correction thus can be carried out at a high speed in the still image shooting mode.

Embodiment X

A tenth embodiment of this invention is provided with an SV release button **220** as shown in FIG. **23**. In this case, the control circuit **219** is arranged to detect the still image shooting mode when the SV release button **220** is operated for a release. In the state of the release, an exposure correcting action is performed at a high speed in the still image shooting mode.

FIG. **24** is a flow chart showing the procedures of control to be performed by the control circuit **219**. Referring to the flow chart of FIG. **24**, a check is made at a step **S211** to find if the release button **220** is in a half-pushed state. If so, the flow comes to a next step **S212**. At the step **S212**: The exposure correcting action is controlled to be performed at a high speed for still image shooting. At a step **S213**: A check is made for the fully-pushed state of the release button **220**. If the release button **220** is found to be in the fully-pushed state, the flow comes to a step **S214**. At the step **S214**: The video signal is subjected to A/D conversion, rate conversion and PCM conversion processes. After that, the recording circuit **217** is caused to record a still image thus obtained.

As described above, the ninth and tenth embodiments are arranged to detect the shooting mode, and to carry out the backlight correction control at a high speed apposite to still image shooting in the case of the still image shooting mode or in a smooth manner apposite to moving image shooting if the shooting mode is the moving image shooting mode. Therefore, the shooting and recording actions can be accomplished appositely to each of the different shooting modes.

Some of the embodiments of this invention are arranged with attention given to the shutter speed. The arrangement of such embodiments is summarized as follows:

A recording image pickup apparatus capable of shooting still images as well as moving images comprises: instructing means for giving an instruction for commencement of still image shooting; detecting means for detecting information on an aperture value and information on an image pickup gain; and control means for controlling a shutter speed and an aperture value of an image sensor on the basis of the instruction for commencement of the still image shooting and an output of the detecting means.

In cases where a high shutter speed is judged to be allowable on the basis of the aperture value and the gain of the AGC, the embodiment controls and increases the shutter speed to a speed apposite to still image shooting, so that an image shake which tends to take place in shooting a still image can be prevented.

The details of these embodiments are as follows:

Embodiment XI

FIG. **25** is a block diagram showing an eleventh embodiment of this invention. The illustration includes a lens group **1001**; an iris **1002**; a CCD (image sensor) **1003**; a sample-and-hold (S/H) circuit **1004**; camera signal processing circuits **1005, 1006** and **1007**; an AGC correction and gamma circuit **1005**; an encoder **1006**; a color processing circuit **1007**; a video signal processing circuit **1008**; an A/D conversion circuit **1009**; a rate conversion circuit **1010**; a PCM conversion circuit **1011**; a recording circuit **1012**; a shutter speed setting circuit **1013**; a light measuring circuit **1014**; an aperture reading circuit **1015**; an aperture setting circuit **1016**; a release button **1017** for still image shooting; and a control circuit **1018**.

The control circuit **1018** is arranged to control the shutter speed, etc., according to the signal of the release button, information on the aperture and information on the AGC gain.

FIG. **26** is a flow chart which shows the flow of the operation of the control circuit **1018** and consists of steps S121 to S130. The flow of operation is as follows:

At the step S122: A check is made for the half-pushed state (on by one step) of the release button **1017**. If so, the flow comes to a step S123. At the step S123: The control circuit **1018** reads aperture value information from the aperture reading circuit **1015**. At a step S124: The aperture value is checked to find if it indicates a full-open sate. If not, the flow comes to a step S125. At the step S125: A shutter speed value and an aperture value are set on the basis of the

relation between the shutter speed and the aperture as shown in FIG. 27(A). Referring to FIG. 27(A), if the read value of aperture is F4.0 while the full-open aperture is F2.0, for example, the aperture can be opened by two steps to F4.0 and the shutter speed can be set at 1/125 sec or 1/250 sec. If the aperture is found to be fully open, the flow comes to a step S126 to read the AGC gain. At a next step S127: The AGC gain is checked to find if it is a maximum value. If not, the flow comes to a step S128. At the step S128: A shutter speed is set on the basis of a relation between the shutter speed and the AGC gain as shown in FIG. 27(B).

The shutter speed thus can be set at a higher speed apposite to still image shooting in cases where the shutter speed is found to be increasable on the basis of the aperture value or the AGC gain.

At a step S129: A check is made for the fully-pushed state (on by two steps) of the release button **1017**. If the release button **1017** is found to be in the fully-pushed state, the flow comes to a step **S130** for still image shooting. If the release button **1017** is found to be in the half-pushed state, the shutter speed setting process continues. If the release button **1017** is found to be in an off-state, the embodiment comes back to its normal moving image shooting state for which the shutter speed is at 1/60 sec.

Embodiment XII

The eleventh embodiment described above is arranged to increase the shutter speed in response to an instruction given from the still image shooting release button **1017**. However, in the case of a twelfth embodiment of the invention, that arrangement is changed to arrange a mode selection switch **1041** for switching between the moving image shooting (MV) mode and the still image shooting (SV) mode in combination with the still image shooting release button **1017**, as shown in FIG. **28**.

FIG. **29** shows the flow of control operation of the twelfth embodiment. At a step **S142**: A check is made for the still image shooting mode. If the shooting mode is found to be the still image shooting mode, the shutter speed is set at a high speed on the basis of the aperture value and the AGC gain through steps **S143, S144, S145, S146, S147** and **S148**.

At a step **S149**: If the still image shooting release button **1017** is turned on, the flow comes to a step **S150** to have the still image shooting carried out. Further, in a case where the shooting mode is found to be the moving image shooting mode at the step **S142**, the flow comes to a step **S151** to have the moving image shooting carried out at the normal shutter speed of 1/60 sec.

As described above, the eleventh and twelfth embodiments are arranged such that, in the still image shooting mode, the shutter speed which is normally 1/60 sec for the moving image shooting is increased to a speed apposite to the still image shooting on the basis of the aperture value and the AGC gain. Therefore, in the case of the still image shooting, an image shake due to hand vibrations, etc., can be prevented by virtue of the higher shutter speed.

What is claimed is:

1. A recording apparatus capable of recording a still image and a moving image, comprising:

detecting means for detecting a release signal for recording the still image;

control means arranged to inhibit driving control of a driving part for a zooming and focusing operation arranged to drive a photo-taking optical system, is response to release signal is detected by said detecting means in a still image recording mode.

2. A recording apparatus capable of recording a still image and a moving image, comprising:

image sensing means;

recording means having a still image recording mode for recording the still image and a moving image recording mode for recording the moving image;

detecting means for detecting an operation state of camera control in the still image recording mode; and

control means, in responsive to the output of said detecting means, for controlling said recording means to inhibit an execution of a still image recording operation when the operation state of camera control for controlling said image sensing means is in a transition period.

3. An apparatus according to claim **2**, wherein said camera control is at least one of automatic white balance control, aperture control and automatic gain control.

4. An apparatus according to claim **3**, wherein said control means inhibits the execution of the still image recording operation of said recording means during the transition period that control parameters of said automatic white balance control, said aperture control and said automatic gain control being changed on the basis of an image sensing state.

5. An image pickup apparatus capable of selectively performing both moving image recording and still image recording, comprising:

light measuring means for performing weighted light measurement on the basis of a light measuring area set in a predetermined position within an image plane;

level detecting means for detecting levels of luminance signals obtained from a plurality of light measuring areas set within the image plane;

determining means for determining a backlight state of an object to be recorded on the basis of an output of said level detecting means;

correction means for correcting a measured light signal outputted from said light measuring means under a backlight shooting condition on the basis of the result of determination made by said determining means; and

control means for performing control in such a manner that a unit of correction step of said correction means in a still image shooting mode is greater than a unit of correction step in a moving image shooting mode.

* * * * *